

SCIENCE

Vol. 102

FRIDAY, AUGUST 3, 1945

No. 2640

<i>Role of Tropical Medicine in International Relations:</i>	
MAJOR GENERAL GEORGE C. DUNHAM	105
<i>The Mastodon and Early Man in America:</i>	
DR. LOREN C. EISELEY	108
<i>Obituary:</i>	
JOSEPH CHRISTIE WHITNEY FRAZER: PROFESSOR WALTER A. PATRICK. <i>Recent Deaths</i>	110
<i>Scientific Events:</i>	
Ordnance Research Laboratories at the Pennsylvania State College; The National Advisory Health Council; The Eli Lilly Award; The Inter-American Typhus Conference in Mexico	112
<i>Scientific Notes and News</i>	114
<i>Special Articles:</i>	
The Hemoagglutinative Properties of Amniotic Fluid from Embryonated Eggs Infected with Mumps Virus: JEANETTE H. LEVENS and DR. JOHN F. ENDERS. Distribution of Radioactive Arsenic Following Intraperitoneal Injection of Sodium Arsenite into Cotton Rats Infected with <i>Litomosoides Carinii</i> : ALFRED H. LAWTON, DR. A. T. NESS, FREDERICK J. BRADY and DEAN B. COWIE. Synergistic Action between Sulphonamides and Certain Dyes against Gram-negative Bacteria: PROFESSOR F. S. THATCHER. Acid Phosphatase in Growing Axons and Degenerated Nerve Tissue: DR. A. M. LASSEK and DR. WALTER L. HARD. Precocious Gonad Development in Oysters Induced in Midwinter by High Temperature: DR. VICTOR L. LOOSANOFF	117
<i>Scientific Apparatus and Laboratory Methods:</i>	
An Application of the Lyophile Process to the Maintenance of Cultures for Microbiological Assay: MAVIS C. NYMON, PROFESSOR I. C. GUNSAULUS and PROFESSOR W. A. GORTNER. Isolation of <i>Trichomonas Vaginalis</i> with Penicillin: DR. GARTH JOHNSON, MARGARET TRUSSELL and FRANCES JAHN	125
<i>Discussion:</i>	
Addition of Carbon Tetrachloride and Chloroform	

to Olefins: DR. M. S. KHARASCH, ELWOOD V. JENSEN and W. H. URRY. "Gall-flower" of the Fig, a Misnomer: DR. IRA J. CONDIT and DR. STANLEY E. FLANDERS. A Gummosis of Citrus Associated with Wood Necrosis: DR. G. H. GODFREY. Why the Rainbow and the Corona Never are Seen in the Same Cloud: DR. W. J. HUMPHREYS. The Naming of Methods, Processes and Techniques for Authors: DR. S. ANDERSON PEOPLES and DR. EMMETT B. CARMICHAEL. Government Aid to Educational Institutions: HAROLD R. RAFTON	128
--	-----

<i>Scientific Books:</i>	
American Forests: DR. RAYMOND J. POOL. Ebulliometric Measurements: DR. EDGAR REYNOLDS SMITH. Infinite Series: PROFESSOR CHARLES N. MOORE. Books Received	132
<i>Science News</i>	10

SCIENCE: A Weekly Journal, since 1900 the official organ of the American Association for the Advancement of Science. Published by the American Association for the Advancement of Science every Friday at Lancaster, Pennsylvania.

Editors: JOSEPHINE OWEN CATTELL and JAQUES CATTELL.

Policy Committee: MALCOLM H. SOULE, ROGER ADAMS and WALTER R. MILES.

Advertising Manager: THEO. J. CHRISTENSEN.

Communications relative to articles offered for publication should be addressed to Editors of Science, 1215 Fifth Avenue, New York 29, N. Y.

Communications relative to advertising should be addressed to THEO. CHRISTENSEN, Advertising Manager, Smithsonian Institution Building, Washington 25, D. C.

Communications relative to membership in the Association and to all matters of business of the Association should be addressed to the Permanent Secretary, A.A.A.S., Smithsonian Institution Building, Washington 25, D. C.

Annual subscription, \$6.00 Single copies, 15 cents

ROLE OF TROPICAL MEDICINE IN INTERNATIONAL RELATIONS¹

By Major General GEORGE C. DUNHAM, U. S. Army

PRESIDENT OF THE INSTITUTE OF INTER-AMERICAN AFFAIRS

MEDICINE plays an increasingly important role in international relations, and particularly in our interdependence with Latin America. For the countries south of the Rio Grande, the practice of tropical medicine is of major significance. Tropical medicine is not only curative medicine, diagnosis and treatment of diseases that tend to occur more frequently in the tropics, but also preventive medicine and public health for the prevention of these diseases.

Any attempt to raise the standard of living where

it is regrettably low in the great mass of the population, as in many American countries, must necessarily entail the extension of public health and care of the sick. The development of relations between the United States and the southern republics is based upon the economic progress and stability of these countries, with attendant political stability. Latin America furnishes a great market for United States products. Economic progress is essential for the development of a profitable market.

Immediately after Pearl Harbor there was a meeting of the Ministers of Foreign Affairs of all the

¹ Address at the annual dinner of the American Foundation for Tropical Medicine, Inc., February 5, 1945.

American republics, in Rio de Janeiro. These men, fully alive to the dangers that faced their countries, took many steps to protect their peoples. One of these measures was the adoption of a resolution calling for international cooperation in the field of medicine and particularly in the field of public health. Within two months the Institute of Inter-American Affairs was created as a means of putting these resolutions into practical effect.

It was realized by all the governments that something had to be done promptly. The danger was acute in the early part of 1942 when there was a real threat of invasion of the Americas by the Axis powers. Had the enemy taken Dakar, there would probably have been at least an attempted aerial invasion. We escaped only by a very narrow margin. Consequently it was felt that measures must be taken immediately to improve conditions in the other Americas with first emphasis upon facilitating the production of strategic materials for war uses, and upon protecting the troops of those countries and of the United States.

In March, 1942, the Institute of Inter-American Affairs began to work first in Ecuador and eventually established operations in eighteen of our neighboring republics—in all except Argentina and Cuba.

Before any work was undertaken an agreement was drawn up between the Institute of Inter-American Affairs and the government of the country wishing to participate in the cooperative health program. This is an international document. The method of operating, adopted after considerable thought and worry, was to put all work on a purely cooperative basis. Small groups of technical people, including doctors, sanitary engineers, nurses and others, were sent to the various countries as operating and advisory field parties. The field party is incorporated within the structure of the national government as a cooperative health service that is part of the local ministry of health.

The chief of each field party represents the Institute of Inter-American Affairs in a given country, and at the same time is in charge of all cooperative operations under delegated authority from the countries. It might be thought that this dual authority would give rise to conflicts, but so far the method has worked with notable success.

The work undertaken is in the form of projects. The minister of health or his representative and the chief of field party decide what should be done, such as malaria control or the construction and operation of a health center. The project agreed upon, funds are made available for it. The whole program is a realistic, practical one because the need for immediate action was urgent. Little time is lost in making

recommendations or handing out advice. The cooperative funds are used for actual health work and for emergency medical care.

At the beginning, most of the funds were appropriated by the Institute of Inter-American Affairs, and the local governments also appropriated funds. Later when work was well under way, extension of the original agreements was proposed, to provide for continuation of the program. In the year or so that had elapsed, the governments had recognized the value of the work and were willing to appropriate more funds, usually on a matching basis. Three of the countries participate on a basis of fifty cents of their money to a dollar from the United States. Others spend more. Brazil has provided five million as against three million dollars on an extension agreement; Bolivia, one million to our half million dollars. The Institute of Inter-American Affairs as now organized will operate until the end of 1948. Programs in Brazil, Chile and Mexico will continue for that period; those in other countries will terminate during the period 1945-1948.

Projects cover the whole field of health work. Hospitals are being built and operated; malaria control, water supplies and sewerage systems are being provided; nursing education is being extended. Over one hundred health centers are being operated throughout the republics. A few health departments have been organized such as the one in Guatemala City, to be run for three years by the Cooperative Service.

Much of the work is being done in undeveloped areas with great possibilities not only for industrial but also for agricultural expansion. The eastern part of Peru and Bolivia and much of Paraguay is largely grassland and sagebrush. Southern Paraguay and the Brazilian state of Matto Grosso, which is about twice the size of Texas, show promise for future growth; so, too, does the vast Amazon basin.

Public health projects are operating extensively throughout the Amazon area. A malaria control project at Belem on the estuary has reclaimed land, provided dikes, tidegates and drainage ditches and protects the airport there. The development of air transportation throughout the tropical countries requires protection from tropical disease for airway passengers. Wherever airports are built, everything possible must be done to combat local communicable diseases.

In cooperation with the Brazilian government, a teaching institute has been established at Belem, a city of over 300,000 people. Known as the Evandro Chagas Institute, it provides in-service training for doctors, nurses and technicians, and specializes in training for work in the Amazon Valley. At San

tarem, up the river about five or six hundred miles, and at Iquitos, Peru, 1,500 miles farther, small hospitals have been established. Malaria control projects are in operation. All the work is cooperative. That in Brazil is being done by Brazilians, with only technical supervision from the personnel of the institute. The Amazon program is being directed by a Brazilian doctor, Dr. Paulo D. C. Antunes, who was trained in the United States.

There are over eight hundred projects of various kinds throughout the southern republics, all of them cooperative; in none of them are we doing the work alone. We are working together with these countries and helping them to improve the health of this hemisphere.

As another example of the work of the program, a malaria survey at Chimbote, Peru, revealed that about 30 per cent. of the townspeople had malaria parasites in their blood. Chimbote is a small town, and its problem is largely a local one, but it has the best deep water harbor on the west coast. There the Peruvian Government put in port works and built a railroad back into the Andes to tap iron and coal deposits. Malaria control was urgently needed. The beach was sandy, with fresh-water pools, the bottom below sea level. Available grades were limited by the elevation of culverts at the upper ends and by the elevation of the ocean at the lower. However, the grade on our main drainage ditches which are now completed is .0004. With a small hospital and health center, with water and sewerage systems which have now been completed, that town will be able to develop economically as it could not do before. The population has already grown from about 4,000 in 1942 to over 8,000.

There are many other factors involved, such as training men to carry on the work. Over 600 men will have been trained in medical and health fields if the institute expires at the end of 1948. Many others are being trained on the job. North American doctors have been sent to Central America for observation of tropical disease treatment and control. After the war there should be an exchange of teachers between this country and our neighbors.

Medical schools in the other Americas are frequently overcrowded. Many operate on the French system, and their courses vary from six to seven years. Through the cooperative health service there is a constant interchange of ideas with the other Americas in the field of medicine. In this way we are building towards a unity in the profession of medicine in all its branches.

Dr. Monge, dean of the medical school at Lima,

Peru, requested a study of their curriculum. Plans to revise the course of study have resulted from the visit of Dr. Weiskotten, dean of the medical school at Syracuse University. If we can have further exchange of ideas and personnel throughout all the Americas, we can do much to unify the medical profession in this hemisphere. The men who come to the United States for study are already doing much to bring about the desired interchange.

Another difficulty rests in the field of medical literature. French text-books are generally used, largely because the United States text-books are too expensive. The tuition at a number of the schools is only about thirty dollars a year. Text-books that sell for five dollars in this country sell for ten or twelve in the southern republics, and these books are English texts. In many of the schools, students study only from lecturers' notes. Text-books can not now be obtained from Europe and those available were published before 1939. Medical journals are also very scarce. Lack of paper has hampered our plans for a monthly edition of the *Journal of the American Medical Association* in Spanish and Portuguese.

The gradual solution of some of these problems has a distinct bearing upon the relations between the United States and these countries. All tropical medicine, all medical care, all public health, are directed toward raising the standard of living which ultimately means economic progress for the hemisphere. All the taxpayers' money spent by the Institute of Inter-American Affairs in the other Americas will come back to the taxpayers of the United States in improved trade relations. More political stability will result through economic development.

The cooperative health service that has been established has demonstrated a facility for withstanding political changes. Several revolutions have occurred, but in no place was the work terminated. In Guatemala, where one of the largest revolutions took place, the work was stopped only a day and a half. Operations continued in Bolivia and El Salvador during non-recognition periods. The program has seen many ministerial changes. In one country the cooperative health service has gone on under six different ministers of health.

The overall objective is to promote economic development and progress. Under present conditions, the limit of foreign trade available in many of these countries is low and can only be increased when the standards of living are raised. Important factors in raising the standard of living are public health and adequate medical care.

THE MASTODON AND EARLY MAN IN AMERICA

By Dr. LOREN C. EISELEY
OBERLIN COLLEGE

IN the light of American discoveries of the last few decades, it has become rather generally accepted that most of the now extinct Pleistocene fauna perished during the closing phases of the retreat of the Wisconsin ice. That this final disappearance was exactly synchronous in every instance is unlikely. The eyes of the geologist and paleontologist must inevitably fail to note the minutia of centuries or even millennia in the vast time expanses over which they range. To accept the survival of many Pleistocene forms into the period of ice retreat, then, is not to define completely the date of their extinction, nor to deny that in some few instances they may, in an attenuated fashion, have reached across the border of Recent time. In our present state of knowledge, arguments as to whether a particular discovery is very late Pleistocene or very early Recent are quite academic, particularly when the geological circumstances can not be related to the ice borders. These facts, would, I believe, be generously admitted by most objective workers in American paleontology and archeology, and, in the long run, they do not greatly affect the question of the time of man's first intrusion into the New World.

There does exist, however, another point of view which may, I believe, be characterized as a minority interpretation. In accordance with it, the life span of certain of these animals, notably the American mastodon, would be brought down into recent centuries. Never thoroughly investigated, so far as the premises upon which it is founded are concerned, this view has been appealed to and reiterated by archeologists committed to theories involving very recent human migration from Asia. As a conception of faunal transitions in the New World, it is worthy of closer examination.

In order to make such an examination, we shall have to engage in a brief survey of the earlier history of paleontology in Europe and America. Before doing so, however, let us set forth the argument for recency as expressed by the eminent paleontologist, William B. Scott. He says: "It was long taken for granted that, when stone weapons were found in association with the bones of Pleistocene mammals, the presence of Pleistocene Man in America was thereby proved. The reasoning was fallacious, for many Pleistocene mammals were in existence *only a few centuries ago, in what is called "historic time in the Old World."* Scott then points out that "Several skeletons of the American Mastodon have been found in bogs, covered by only a few inches of peat with more or less of the hair and recognizable contents

of the stomach preserved.¹ Such fossils can be of no great antiquity, and they all occur in Post-Pleistocene deposits, *laid down after the complete disappearance of the Glacial Ice*"² (Italics mine. L. E.).

A few decades ago, to have asserted the existence of the mastodon within recent centuries would have occasioned no surprise. Similar ideas were entertained by many eighteenth and early nineteenth century writers who were locked in a religious ideology which demanded such survival.³ Even as late as the eighteen eighties there were suggestions that the Mound Builders had achieved their constructions through the domestication of the mammoth and his utilization as a draft animal. Statements of this sort could pass well-nigh unchallenged, because American archeology was almost completely undeveloped, and no carefully documented sites, no confirmed cultural sequences with accompanying fauna were available.

To-day over large areas of the United States such sequences are known. Whatever the exact date of the disappearance of the American elephants, there exists no single iota of reliable information to show that the American mastodon or, for that matter, any of the other vanished Pleistocene forms, survived recently enough to have been hunted by those peoples who we now know inhabited the Eastern woodlands "a few centuries ago."⁴ This devastating evidence is ignored by those unacquainted with the extensive defining of archeological horizons and their accompanying faunas,

¹ Since the animal's food consisted largely of twigs, their survival in bog waters, which preserve vegetable substance for millennia, is in no wise remarkable. As for the hair, this has become an item of paleontological folklore which the writer proposes to examine elsewhere. Its documentation is old, scanty and untrustworthy.

² W. B. Scott, "A History of Land Mammals in the Western Hemisphere," Macmillan, N. Y., 2nd ed., revised, 1937, p. 260.

³ L. C. Eiseley, *American Anthropologist*, 47: 318-320, 1945. See also "Myth and Mammoth in Archeology," *American Antiquity* (in press).

⁴ The writer would indicate his awareness of the problem presented by the discovery of ceramic remains reported in association with a South American species of mastodon, *Cuvierionius postremus*, in Ecuador. Considering the fact that *Neohippus andium* and *Mylodon robustus* were also reported from this site, its archeological neglect has been scandalous. If the site had been claimed as "Pleistocene" many experts would undoubtedly have journeyed even to this out-of-the-way location. The claim for genuine association under conditions suggesting marked recency has satisfied many, but in actuality a really thorough investigation of this find has never been made, at least in terms of what would be demanded in connection with Folsom investigations in North America. The plain truth is that a certain unpleasant suggestion of neglect has not contributed to the prestige of this particular discovery. In any case, however, the faunal extinctions in South America present a special problem

which has been carried out in the last few decades. Lest I be misinterpreted, let me reiterate: This evidence is not sufficient, at present, to determine the exact time of disappearance of the American elephants. It is sufficient, however, to remove that extinction to a period preceding the rise of the known Amerindian cultures. Work in the Plains area and in the Southwest has yielded nothing to contradict this position.

Still to be considered, however, are Scott's comments upon the mastodon remains buried in American peat bogs. Hair and the existence of fatty tissue have been made much of as demanding the utmost recency, and as quite distinct from the situation in which mammoth finds have been recovered in Europe. It was not long after the colonization of the New World commenced before travelers began to comment upon the huge bones found in the New World. They seemed strewn in greater profusion, to be, in short, more suggestive of recency. Sir Charles Lyell makes note of such occurrences in several of his writings, one such instance being recorded in his "Travels in North America,"⁵ where he remarks on the finding of mastodon in bogs which in England almost never yield elephant remains. Nevertheless, Lyell is quick to comment, in connection with a more northerly bog site⁶ which he himself helped to excavate, that mastodon remains which he had been told lay in superficial earth were really buried in shell-marl below the peat. Irrespective of this observation, however, several points can be made in connection with these bog deposits.

First of all, the apparent number of visible remains of mammoth and mastodon as chronicled by earlier writers in the New World is not so remarkable when we consider the unpeopled character of the American wilderness and the cultural status of the American aborigines. Europe, by contrast, had destroyed countless thousands of its fossil bones before it had learned to value them. Digby comments that there is evidence that mammoth ivory was a fairly familiar article of trade in early Greek civilization.⁷ Alfred Haddon has noted the destruction of fossil remains occasioned in the sixteenth and seventeenth centuries by the search for the unicorn's horn, regarded as a specific for many diseases.⁸ In addition it is known that fossil bones were sometimes utilized as fertilizer.

which will have to be surveyed on its own merits. Survivals there do not necessarily demonstrate North America lingers any more than the existence of the African elephant proves the late survival of the mammoth in Europe.

⁵ Vol. I, p. 54, London, 1845.

⁶ *Ibid.*, p. 45.

⁷ Basset Digby, "The Mammoth and Mammoth Hunting in Northeast Siberia," pp. 19-20. London, 1926.

⁸ "History of Anthropology," p. 81. London, 1934.

It must furthermore be remembered that the last great ice advance in North America extended much farther southward than in Europe. The bogs and the bog fossils of Indiana and New York, even though Post-Glacial, need not be as young in point of time as bogs in Europe lying in more northerly latitudes. It is here that Dr. Scott's assertion about the "complete disappearance of the Glacial Ice" becomes ambiguous. Not all these bogs are of the same degree of antiquity⁹ nor, even if they were, would this prove that the ice had completely disappeared at the time the bogs began to be laid down on the drift of the old ice borders. All that such evidence actually proves is the survival of the mastodon into the period of ice *recession*, where the glaciers were in retreat from their areas of maximum advance. It would be of service if we had pollen spectra from the exact location in the bogs of these mastodon remains, but so far none have been forthcoming.

In Europe it is known that the mammoth, already rare, lingered close to the border of recent time¹⁰ and that in Spain *Elephas antiquus* may have survived almost as long. No one, however, in the long cultural range of the Mesolithic and Neolithic, has brought them farther forward into time. Yet there is reported an instance of a mammoth skull with "the bones fresh-looking and full of undecomposed gelatine"¹¹ (Italics mine. L. E.). And this not from bog waters but the Rhineland loess! Nowhere, when mastodon remains from the drift borders of the American ice are discussed, have the following facts been dwelt upon: (1) The preservative effects of bog waters and insulating muck: It is not surprising, under such circumstances, where delicate pollens and the membranous tissues of plants are preserved for thousands of years, that insect wings and the chemically transformed marrow of the long bones may be similarly insulated from bacteria, and hence survive. (2) It has never been adequately pointed out that the eastern mastodon, a browser of forest habitat, was far more apt to leave his remains in bogs than the European mammoth—a steppe and tundra feeder—which preferred the open. The latter did not frequent those European areas which have left us the most extensive remains from the peat beds—a fact which was not realized by Lyell. Hence, the rarity of mammoth remains in the peat deposits of Europe is not, upon ecological reasons alone, a fair basis for comparison between the Old World and the New. The American mastodon was an animal of seemingly quite different habits—ones

⁹ L. C. Eiseley, *American Antiquity*, 5: 115-140, 1939.

¹⁰ J. G. D. Clark, "The Mesolithic Settlement of Northern Europe," Cambridge, 1936. H. F. Osborn, "Proboscidea," Vols. I and II, N. Y., 1936-1942.

¹¹ H. H. Howorth, "The Mammoth and the Flood," p. 161. London, 1887. The find, it should be noted, is reported by the distinguished naturalist, Falconer.

which made him peculiarly vulnerable to entrapment in the muck and peat deposits so common to the eastern woodlands of immediately post-glacial time. Whether he found that habitat endurable for a somewhat longer period than the European mammoth was able to survive in Europe, we do not know at present. But we do know that his life span did not extend into the time of the archeologically known horizons, and, in addition, we must confess that his presence in bogs on the southward drifts is not sufficient to clarify his age accurately enough that we may assert his survival into recent centuries.

These bogs can not be correlated with those of Scandinavia and the North German plain with anything like the necessary degree of exactitude which would validate Scott's assertion of extreme recency. We merely know that both are Post-Glacial in their particular latitudes, and that is all. There exists no evidence, at present, which seems to demand in the

New World a lingering extinction of the American elephants in a way much different from the course of events in Europe. But it would be well to bear in mind, in future studies, that the eastern mastodon was a creature whose way of life was by no means entirely comparable to that of the mammoths. When this is realized, his more numerous presence in bogs on the early drift may be better understood. Moreover, it will reduce the tendency to make casual and ill-aimed comparisons between the sparsity of such remains in Europe and their frequency in the New World. The problem of mastodon antiquity will eventually be solved on other evidence. This writer is quite willing to admit that the solution is not evident at the present time, but he does not feel that the above facts can be made to fit into an easy and superficial dogmatism about the recency of survival of the American elephants within the last few centuries.

OBITUARY

JOSEPH CHRISTIE WHITNEY FRAZER

JOSEPH CHRISTIE WHITNEY FRAZER died in Baltimore on July 28, 1944. His death marks the loss of the last direct link with the Remsen influence. He is mourned with sadness at Johns Hopkins, and the activities and creative accomplishments of this great Hopkins chemist are hereby inadequately recorded by one of his friends.

An English Jesuit once said, "It is surprising how much good a man may do in the world if he allows others to take credit for it." The intense devotion of Frazer's students and associates is partly explained by his unselfishness, but the strength of the bond between him and his inner circle was largely the result of his kindly penetrating judgment. It was wisdom enriched by a voracious appetite for scientific literature and finely tempered with a sympathetic feeling for the vagaries of the human soul. The affectionate title "the Boss" was a feeble attempt by his students to express their belief in his wisdom and their faith in the gentleness of his rule.

J. C. W. Frazer was born on a farm in Kentucky on October 30, 1875. He attended Kentucky State College (later the University of Kentucky) in Lexington, from which he received the B.A. and M.A. degrees. It was here that his enthusiasm for chemistry was kindled by a great teacher, Joseph H. Kastle. It was this latter man who aroused in young Frazer a love for the robust form and vivid coloring of physical experiment. It was he who distilled into Frazer's thinking a strong tincture of scepticism, without which no modern man of science may guide himself through the welter of data and ideas.

Frazer then came to the Johns Hopkins where he worked under the direction of Ira Remsen and H. N. Morse. It is indicative of his mental processes that he did not follow the brilliant, highly articulate, encyclopedic Remsen, but rather the careful, precise technician Morse. The latter would lecture for months on the analytical balance, and for weeks on the Bunsen burner. After Frazer obtained his degree in 1901 he became assistant to Morse and proceeded to the task of the exact measurement of osmotic pressure. This painstaking work is recorded in numerous papers, but never can enough be said of the endless difficulties that beset the path of these two investigators. It was a struggle, with a most critical margin, against selective porosity. They succeeded brilliantly with some measurements, but finally, as the work progressed, it became evident that instead of being a fundamental clarifying concept in the theory of solutions, osmotic pressure was a complicated manifestation that could be simply characterized only in idealized cases. With his penetrating, uncanny knack of getting at the bottom of things Frazer clearly saw that the theory of solutions, especially electrolytes, demanded stronger tools of investigation than utopian semipermeable membranes, and accordingly turned to measurement of vapor pressure of true solutions and osmotic pressure of colloidal or high polymer solutions.

Here follows the only interruption of his Hopkins association—a four-year position as research chemist in the Bureau of Mines. It was here that the work of Frazer laid the foundation of exactness and experi-

mental rigor that have been associated with the activities of this great government institution.

Upon his return to Hopkins in 1911 he plunged into his long planned project of the exact measurement of the vapor pressures of aqueous solutions of non-volatile solutes. He selected the direct approach, *i.e.*, static measurements under conditions of exact temperature and freedom from permanent gases. His results still stand as a model of careful measurement. Once G. N. Lewis singled out Frazer's values as being not entirely accurate because of the fact that they did not obey a particular subjective method of thermodynamic graphic plotting. Lewis did not appreciate the important role of hydration of the solute, but this point did not escape the notice of Frazer, who took the position that the method of measurement was exact within the limit stated.

The vapor pressure work was interrupted by the advent of World War I, and inasmuch as the chemical war work originated in the Bureau of Mines it was an obvious choice to enlist the services of the Chemistry Department of the Johns Hopkins. Frazer selected once more an important problem, and also, characteristically, solved the same completely. Never was the nature of the man better illustrated than in his action in the ensuing years. He was a full professor and director of the Chemical Laboratories at this time, and positions of power and authority in the council of the men of science at war work were his for the asking. Yet he never turned aside from the pursuit of his immediate experimental goal, he never strove for high administrative office, he never tried to gain stature by any manifestation of showmanship, he remained his cool, contemplative self, always thinking of his experimental problem. The task selected by Frazer was the old one of low temperature oxidation of carbon monoxide. Since many minds were working on the problem, the history of the final conquest must therefore be complicated. All the other investigators firmly believed that the catalyst manganese dioxide would not function alone, but required the addition of promoters. To Frazer belongs the credit of being first to realize that *pure* manganese dioxide was the active agent, and was alone sufficient to bring about the oxidation. As soon as his initial period of investigation put him on the correct path, he proceeded forthwith to the final solution of the problem by a series of brilliant and highly ingenious experiments. The conclusion of the investigation produced the catalyst Hopcalite, named by Frazer and Bray (of the University of California) after their respective universities.

This outstanding experimental achievement turned Frazer definitely toward the baffling problem of heterogeneous catalysis in general. While this field

was highly suitable for the display of his prodigious knowledge of inorganic chemistry, it is unfortunate that he did not turn his discerning experimental talents toward the solution of a problem not involving the extremely uncertain interpretation of kinetic measurements. Most great chemists have labored with the desire of correlating time with chemical changes of state, but up to the present the proper frame of conception has eluded them. Frazer was keenly aware of the imperfect state of our fundamental knowledge of catalysis and was constantly probing for a crucial opening wedge in the problem. He read and sifted all the theories, he studied many related phenomena, such as adsorption, surface energy, crystal structure and complex compounds. During all this time he contributed many important experimental data.

At the time of his death he was deeply engaged in private experimental work of fundamental significance, as subsequent revelations will prove, and also had been for more than two years directing an N.D.R.C. investigation.

He was a man of few words, never having, as he was wont to say, the "gift of gab," but his words were always to the point at issue, and it seemed as if he distilled from his ever present pipe a subtle emanation that was clarifying and soothing. In his day he had been an outstanding athlete, but in his later years he remained closer to his laboratory where he taught and toiled. He loved the spirit of research which has always permeated Hopkins and was fond of quoting a remark of Professor F. G. Donnan, who once told Frazer that the Hopkins Chemistry Laboratory was one of the world's great experimental centers. Frazer's honesty was of such a caliber that he never fooled even himself; he knew the exact nature of his training and therefore his own capabilities. In fact, as he modestly put it, scientific research is only "a peep into the future."

WALTER A. PATRICK

THE JOHNS HOPKINS UNIVERSITY

RECENT DEATHS

DR. FRANK BLAIR HANSON, associate director of the Division of Natural Sciences of the Rockefeller Foundation, died on July 21 at the age of fifty-nine years.

DR. FREDERIC E. CLEMENTS, of Santa Barbara, Calif., from 1917 until his retirement in 1941 associate in ecological research of the Carnegie Institution, died on July 26. He was in his seventy-first year.

DR. ROSCOE GILKEY DICKINSON, professor of physical chemistry and dean of the Graduate School of the California Institute of Technology, died on July 13 at the age of fifty-one years.

DR. RICHARD PRAGER, research associate in astronomy at Harvard University, an authority on variable stars, died on July 21. He was sixty-one years old.

DR. GEORGE W. RAIZISS, professor of chemotherapy at the Graduate School of Medicine of the University of Pennsylvania and director of the department of chemical dermatological research of the Abbott Laboratories, died on July 16 at the age of sixty-one years.

DR. FRANK WILLIAM DOUGLAS, professor of chemistry and head of the department of Colorado College, died on July 19 at the age of sixty-six years.

DR. H. B. ARBUCKLE, from 1913 to 1937 professor of chemistry of Davidson College, North Carolina, died on July 19 at the age of seventy-four years.

DR. E. W. ENGLE, research and consulting metallurgist for Carboloy Company, Inc., an authority on tungsten and tungsten carbides, died on April 26 at the age of fifty-seven years.

DR. HEINRICH CARL REDEKE, of the department of hydrobiology of the University of Amsterdam, died on April 10 at the age of seventy-one years.

DR. CHAUNCEY D. LEAKE, dean of the School of Medicine at Galveston of the University of Texas, writes: "You may be interested in a news item recently sent to me by Dr. Raymond L. Cahen, one of the former associates of Dean Marc Tiffeneau. Dean Tiffeneau, of the Faculté de Médecine of Paris, died suddenly in June from a heart attack. Dean Tiffeneau was born in 1875 and was head of the department of pharmacology and dean of the Faculty of Medicine. He was a leader in the development of synthetic organic chemistry in France and well known for his studies on the mechanism of cellular sensitivity to poisons. He was largely responsible for the introduction of ouabain in medicine and was responsible for the introduction of bioassay standards for France. His 'Annual Reviews of Pharmacology' were long a feature of French clinical journals. He was a member of the Académie des Sciences and of the Académie de Médecine. He was the representative for France on the International Committee of Narcotics Control and on the International Pharmacopoeia."

SCIENTIFIC EVENTS

ORDNANCE RESEARCH LABORATORIES AT THE PENNSYLVANIA STATE COLLEGE

THE U. S. Navy has completed arrangements for the establishment of two permanent ordnance research laboratories which will be in operation by fall at the Pennsylvania State College under a Bureau of Ordnance contract. The establishment of these laboratories is in keeping with the policy of forming research affiliations with educational institutions to further development of naval weapons and for educational purposes in such military problems during the postwar period.

The Ordnance Research Laboratory, dealing with underwater ordnance, will be housed in a new building now under construction. The work will be a continuation of the research formerly carried on by the Underwater Sound Laboratory at Harvard University which has been sponsored by the Office of Scientific Research and Development, with technical direction from the Bureau of Ordnance. Dr. Eric A. Walker, who was in charge of the Ordnance Research Division at Harvard, will direct the new laboratory and also will be the head of the department of electrical engineering.

Assistant directors of the laboratory will be A. N. Butz, Jr., who formerly operated a private electronics research laboratory; R. R. Thompson, formerly associated with the Bell Telephone Laboratories and the Humble Oil and Refining Company, and Dr. Harvey Brooks. All these men are now affiliated with the

Harvard University Laboratory. A staff of approximately one hundred and twenty-five scientists, technicians and clerks will be transferred from the Harvard Laboratory to the new unit. In addition to the work that will be carried on in the Ordnance Research Laboratory, this laboratory will also operate a calibration station at the Black Moshannon Lake, approximately twenty miles from State College, and a test station at Fort Lauderdale, Fla.

The Petroleum Refining Laboratory has been in operation for approximately sixteen years. During the present war emergency, it has also been under sponsorship of the Office of Scientific Research and Development. The plan is for this laboratory to continue with the petroleum research under a direct contract with the Bureau of Ordnance, including special work for and technical reports to the other services. Dr. M. R. Fenske will continue as director, a position that he has held since the laboratory was established. Assisting Dr. Fenske is Dr. Dorothy Quiggle and R. A. Rush. The staff of the laboratory includes more than fifty chemists, chemical engineers and technicians.

The Ordnance Research Laboratory has been placed under the School of Engineering (H. P. Hammond, *dean*), and the Petroleum Refining Laboratory is under the School of Chemistry and Physics (F. C. Whitmore, *dean*). Most of the scientific and technical personnel will hold academic appointments on the faculty of the college.

THE NATIONAL ADVISORY HEALTH COUNCIL

THE National Advisory Health Council met at Public Health Service headquarters in Bethesda, Md., on June 19 and 20.

The two-day session was devoted to discussion of the current and future activities of the several bureaus of the Public Health Service.

Surgeon General Thomas Parran, in opening the meeting, called attention to the legal functions now vested in the National Advisory Health Council under the provisions of the Public Health Service Act of 1944 (P.L. 410). Before the passage of this law, the council served solely in an advisory capacity. Now the council has the legal responsibility to

(1) . . . advise, consult with and make recommendations to the Surgeon-General on matters relating to health activities and functions of the service; and to serve in other capacities as requested;

(2) Recommend research projects for grants-in-aid in scientific fields other than cancer research, and recommend other procedures for the advancement of scientific research;

(3) Recommend the adoption of regulations by the service with respect to interstate quarantine for the prevention of communicable diseases, including regulations for the apprehension, examination and detention of persons who are spreading disease.

The programs of the Sanitary Engineering Division, the Bureau of Medical Services and the Bureau of State Services were discussed on the first day. On the second day, a proposed plan for the training of Public Health Service personnel was presented by the Division of Public Health Methods; the Nurse Education Division presented proposals for the postwar nursing program; and the work of the National Institute of Health was discussed.

The council recommended the approval of a grant-in-aid of \$92,000 to the University of Utah for research on muscular dystrophy. This is the first grant-in-aid for general research projects to be made under the provisions of P.L. 410.

Among other important decisions of the council were recommendations that

(1) A committee of the council be appointed to act with designated officers of the service in the development of a program of clinical research;

(2) The Public Health Service strengthen its control of the interstate spread of disease through consultant services to public health laboratories and through maintenance of a \$1,000,000 emergency fund to be used in epidemics and disasters;

(3) The Public Health Service undertake demonstrations in selected communities of generalized public health nursing programs, including bedside care;

(4) The Public Health Service establish a training

program for its own personnel, which would include orientation, work experience, observation, in-service training and opportunities for state and local personnel to participate;

(5) The program of grants-in-aid and technical services to the states in the field of industrial hygiene be expanded;

(6) The Public Health Service seek appropriations for grants-in-aid for general research to be allotted to qualified institutions and individuals;

(7) When the Federal Government undertakes grant-in-aid programs related to public health and sanitation, the Public Health Service be empowered to conduct investigations for determination of the nature and extent of the problems involved and to approve the allocation of funds, functional effectiveness and placement of plants, installations and constructions required of such programs.

In addition, the council approved the policy of the Public Health Service on national programs for the control of water pollution.

Regular meetings of the council will be held twice a year; special meetings will be called as needed. Council members are to serve as chairmen of special committees dealing with specific subjects.

THE ELI LILLY AWARD

THE Eli Lilly and Company Award in Biological Chemistry for 1945 was presented to Dr. Max A. Lauffer, of the University of Pittsburgh and formerly of the Rockefeller Institute, at a special meeting of the Pittsburgh Section of the American Chemical Society in the Stephen B. Foster Memorial of the University of Pittsburgh on June 21. The award was made at a meeting of the section of which the recipient is a member because a spring national convention of the American Chemical Society was not held this year.

Dr. Harold K. Work, chairman of the Pittsburgh Section, introduced the speakers: R. Adams Dutcher, who expressed his impressions of "The Recipient and His Field of Work"; Dr. Charles A. Parsons, who presented the award to Dr. Lauffer on behalf of the American Chemical Society, and the medalist, Dr. Lauffer, who gave an address on "Influenza Virus" in which he pointed out that the cause of influenza was a matter of conjecture until 1933, when it became evident that the probable cause was a filterable virus. This virus can be conveniently propagated in the chorio-allantoic membrane of chick embryos and purified from the embryonic fluid by high-speed centrifugation.

With the electron microscope Dr. Lauffer showed that purified virus preparations contain three types of particles—small granules, medium-sized spheres (about 115 μ in diameter) and clusters of these spheres. From ultracentrifuge experiments and density measurements, it was found that the spherical particles contained 60 per cent. water. Chemical

determinations by other investigators showed that the other 40 per cent. was 70 per cent. protein, 24 per cent. lipid and 6 per cent. carbohydrate. From this analysis influenza virus resembles a small organism more than a large molecule.

By using a separation cell in the ultracentrifuge it was possible to show that biological activity of influenza virus is associated with the 115 μ spheres and their aggregates and not with the small granules. This cell has a barrier about half way down, so that after ultracentrifugation, top and bottom layers can be removed and tested separately. Correlation between biological activity and content of particles can then be established in the two layers.

The conclusion that influenza virus is a particle 115 μ in diameter was confirmed by the finding that this particle and biological activity migrated with the same speed under an electric field in the Tiselius apparatus.

The Eli Lilly and Company award of \$1,000 and a bronze medal is made annually to an American scientist under thirty-five years who has accomplished outstanding research in biological chemistry. The purpose of the award is to stimulate fundamental research in biological chemistry in the United States.

THE INTER-AMERICAN TYPHUS CONFERENCE IN MEXICO

THE Public Health and Welfare Department (Secretaría de Salubridad y Asistencia) of Mexico is calling an Inter-American Typhus Conference to be held in Mexico City from October 7 to 13, sponsored jointly by the Institute of Inter-American Affairs and the Pan American Sanitary Bureau.

The purpose of the conference is to bring together leading workers in the typhus field in the American Republics in order that they may present and discuss the latest developments, both in the field of research and in the practical control of the disease.

Inasmuch as epidemic typhus is a serious problem in many of the American Republics and leader of the typhus control program in the United States Armed Forces have experienced success in the control of this disease, it is believed that the calling of such a conference is opportune.

Invitations to leading scientists are being issued but other individuals who have an interest in the subject will be welcome to attend the meeting. Correspondence should be directed to the Secretaría de Salubridad y Asistencia, Mexico, D. F.

SCIENTIFIC NOTES AND NEWS

DR. T. WAYLAND VAUGHAN, emeritus director of the Scripps Institution of Oceanography, has been awarded the Mary Clark Thompson Medal and honorarium of the National Academy of Sciences for 1945, in "recognition of outstanding achievement in his purposeful and ingenious coordination of observations and generalizations made in and bearing on the fields of stratigraphic geology and paleontology."

DR. FRANCIS G. BLAKE, Sterling professor of medicine and dean of the School of Medicine of Yale University, was presented with the Charles V. Chapin Memorial Award for 1945 of the City of Providence during the one hundred and thirty-fourth annual meeting of the Rhode Island Medical Society. The presentation was made by Hon. Dennis J. Roberts, mayor of Providence, following the delivery of the annual Charles V. Chapin oration. This lecture was entitled "Some Recent Advances in the Control of Infectious Diseases."

COLONEL EDWARD T. WENTWORTH, M.C., A.U.S., organizer and commander in Europe of the nineteenth General Hospital, has been named Albert David Kaiser medalist of 1945 by the Rochester Academy of Medicine "for outstanding services to the medical profession of county and state and for zeal in ministering to the defenders of our country in two wars."

THE Legion of Merit of the Army has been awarded to Lieutenant Colonel John A. Geddes, formerly research chemist of E. I. du Pont de Nemours and Company.

THE Osler Memorial Medal of the University of Oxford for 1945 has been awarded to Professor C. G. Douglas, F.R.S., tutor in natural sciences and fellow of St. John's College.

THE gold medal of the British Royal Society of Medicine was presented on July 4 to Brigadier Sir Lionel Whitby at the annual meeting of the society. The medal is awarded triennially to "a man or woman who has made valuable contributions to the science and art of medicine." It was awarded to Sir Lionel Whitby in recognition of his distinguished work in relation to the problems of wound shock and the transfusion of blood and the blood derivatives.

THE American Society of Plant Physiologists has elected the following officers for terms beginning July 1: *President*, Dr. Paul J. Kramer, Duke University; *Vice-president*, Dr. Earl S. Johnston, Smithsonian Institution; *Secretary*, Dr. Robert B. Withrow, Purdue University; *Member of Executive Committee*, Professor D. R. Hoagland, University of California; *Member of Editorial Board of Plant Physiology*, Dr. H. A. Spoehr, Carnegie Institution of Washington.

AT Columbia University, the retirement with the title professor emeritus is announced of Dr. William King Gregory, vertebrate paleontology; of Dr. James Wesley Jobling, pathology; of Dr. Alwin Max Papenheimer, pathology; of Dr. Walter Rautenstrauch, industrial engineering, and of Dr. Marie Reimer, chemistry.

DR. MAYNARD K. HINE has been made dean of the Indiana University Dental School. He succeeds Dr. William H. Crawford, who was recently appointed dean of the Dental School of the University of Minnesota.

DR. MACDONALD FULTON, formerly professor of bacteriology at Southwestern Medical College, Dallas, has been appointed visiting professor of pediatric research at the Medical Branch at Galveston of the University of Texas. He will be in charge of bacteriological studies relating to *Salmonella* organisms as part of the Child Health Program supported by the William Buchanan Foundation of Texarkana.

AT Western Reserve University, Dr. James A. Doull, head of the department of preventive medicine and public health, will occupy the newly established Elisabeth Severance Prentiss Chair in Preventive Medicine. This department is financed by the annual income from the Elisabeth Severance Prentiss Fund. It is hoped that this sum will be increased by grants from foundations and other sources.

DR. WILLIAM C. BELL has been appointed assistant professor of paleontology and stratigraphy at the University of Minnesota to fill the position left vacant by Dr. C. R. Stauffer, who retired on June 30. Dr. Bell is now in the Army Air Corps, where he has served as supervisor of instruction at an Advanced Navigation School, and photo intelligence officer at a Combat Crew Training Station. He will take over the work at the university as soon as his military services are terminated.

DR. EDWARD L. TATUM, assistant professor of biology at Stanford University, has been appointed associate professor of botany at Yale University.

DR. HERBERT C. MILLER, assistant professor of pediatrics at the Yale University School of Medicine, has become professor and head of the department of pediatrics of the School of Medicine at Kansas City of the University of Kansas.

DR. A. R. KEMMERER, chemist for the Texas Agricultural Experiment Station, has been appointed head of the department of human nutrition of the Agricultural Experiment Station of the University of Arizona, effective on September 1.

DR. WARREN J. MEAD, of the Massachusetts Institute of Technology, who has been on leave of absence

to serve as director of Reynolds Research at Glen Cove, L. I., during the war period, has resumed his work as head of the department of geology of the institute. He will continue to act as research consultant for the Reynolds Metals Company.

PROFESSOR MELVIN L. MANNING, director of the High Voltage Research Laboratory at Cornell University, has resigned to become assistant chief engineer of the Kuhlman Electric Company in Bay City, Michigan.

DR. W. A. SELLE, professor of physiology at the Medical Branch at Galveston of the University of Texas, is for several months a guest research worker at the Massachusetts Institute of Technology on problems in physical medicine under the auspices of the Baruch Committee on Physical Medicine.

DR. WILMA T. DONAHUE has been appointed director of the Michigan Psychological Services of the Institute for Human Adjustment at the University of Michigan. Michigan Psychological Services is a facility for extending the university's program in research, training of professional workers and service in the field of clinical psychology.

DR. FRANK L. GUNDERSON, biochemist, executive secretary of the Food and Nutrition Board of the National Research Council, Washington, will become associated in October with Pillsbury Mills, Inc., in Minneapolis, where he will be concerned with product research and development. It is expected that he will continue work with the Food and Nutrition Board and its committees on an occasional consulting basis.

DR. WILLIAM L. JELLISON, of the National Institute of Health, has been detailed to the War Department upon its request, to serve at the Field Headquarters of the United States of America Typhus Commission in the India-Burma Theater.

DR. JAMES WATT, of the U. S. Public Health Service; Dr. W. W. Frye, of Vanderbilt University, and Dr. H. A. Reimann, of Jefferson Medical College, Philadelphia, are members of a group which is now *en route* for China to assist in fighting a cholera epidemic in Chungking. The expedition is being sent out under the auspices of the United Nations Relief and Rehabilitation Administration.

THE British Committee of Privy Council for the Organization and Development of Agricultural Research has appointed Professor T. G. B. Osborn, Dr. J. L. Simonsen, F.R.S., and W. J. Wright as members of the Agricultural Research Council in succession to Professor E. J. Salisbury, F.R.S., Sir Robert Robertson, F.R.S., and Sir Robert Greig, whose terms of office as members of the council have expired.

DR. CARL L. HUBBS, of the Scripps Institution of Oceanography, writes to SCIENCE that he has received word from Dr. F. P. Koumans that the Rijksmuseum van Natuurlijke Historie at Leiden, Holland, and its collections are undamaged and that he and his family are well.

THE annual meeting for initiation of new associates and members of the Stanford Chapter of Sigma Xi was held on the evening of May 30. The president of the chapter, Professor George Parks, announced the election of twenty-three associates and seventeen members, and presented diplomas to those who were able to be present. An address on the "Origins of the Experimental Method" was given by Professor F. O. Koenig, of the department of chemistry. Officers of the chapter for the coming year are: *President*, Professor Gabor Szegö, mathematics; *Vice-president*, Professor Paul Farnsworth, psychology; *Secretary-Treasurer*, Professor Willis Johnson, biology; *Assistant Secretary-Treasurer*, Professor Hubert Loring, chemistry.

THE annual meeting of the chapter of Sigma Xi at Lehigh University was held on the evening of June 6. The meeting was preceded by a dinner at which sixty-two members and guests were present. President Lawrence Whitecomb received into membership five members and three alumni members. The election of officers for 1945-1946 was announced as follows: *President*, Professor T. H. Hazlehurst; *Vice-president*, Professor W. J. Eney, and *Secretary*, Assistant Professor R. D. Stout. Professor John M. Fogg, Jr., of the University of Pennsylvania, gave the annual address, entitled "Studies on the Flora of Pennsylvania." The attendance at the lecture was over one hundred.

THE Electron Microscope Society of America is planning to hold its third annual meeting on November 30 and December 1 at the Frick Chemical Laboratory of Princeton University. The purpose of the meeting is to acquaint the members with the rapid advances in the past year in the applications and techniques of electron microscopy and diffraction in currently important problems in physics, chemistry and biology. As a result of the acute transportation shortage and in accordance with the rules of the Office of Defense Transportation, the attendance at the meeting will be limited to those living in the commuting area of Princeton, N. J., and to fifty members from outside this commuting area. Those falling into the latter category must apply for permission from the Program Chairman, John Turkevich, Department of Chemistry, Princeton University, Princeton, N. J.

Industrial and Engineering Chemistry states that the McDonough Bill, which has been introduced in

Congress, provides for the release of scientists now in military service and for the deferment of a minimum number of students annually to pursue studies in science at the universities. The journal points out that "passage of this bill would begin the restitution that must be made to rebuild our scientific resources and that responsibility for its active support lies with every scientist in America."

It is reported in *Chemical and Engineering News* that the House of Representatives passed unanimously June 19 the May Bill, H.R. 3440, which authorized an annual appropriation of \$8,000,000 to the National Academy of Sciences for a permanent program of post-war military and naval research in technical and scientific fields. The bill has been sent to the Senate, where approval is expected. Activities would be directed by a Research Board for National Security, made up of Army, Navy and other government officials. During the debate on the measure, Representative Gordon L. McDonough, of California, sponsor of H.R. 2827 which would exempt scientists and other key personnel from the draft, said that the United States is the only nation that has failed to provide adequate safeguards against the loss of needed chemists, engineers, physicists and other highly skilled personnel. Representative Walter H. Judd, of Minnesota, joined in the criticism, asserting that the United States is systematically destroying our potential scientists of to-morrow without realizing the seriousness of the situation.

THE scope of the *Polymer Bulletin*, inaugurated in April, 1945, under the auspices of the Bureaus of High Polymer Research at the Polytechnic Institute of Brooklyn, will be extended when on January 1 it will become a national *Journal for High Polymer Research*. It will be devoted to the publication of original papers and surveys in the entire field of the chemistry and physics of high polymeric substances. It will reflect mainly the scientific progress and development in the field of plastics and elastomers. The editor will be Dr. H. Mark, and the assistant editors, Drs. Paul M. Doty and Charles C. Price. The editorial board will be composed of well-known American and foreign scientific men. It is published by Interscience Publishers, Inc., New York.

IN consultation with the War Policy Committee, the president and secretary have made arrangements to hold the summer meeting of the American Mathematical Society at the New Jersey College for Women, Rutgers University, from September 15 to 17. By invitation of the Program Committee, Professor S. S. Chern, of the Institute for Advanced Study at Princeton, will deliver an address on "Some New Viewpoints in Differential Geometry in the Large";

Professor Samuel Eilenberg, of the University of Michigan, an address on "Topological Methods in Abstract Algebra," and Professor Witold Hurewicz, of the University of North Carolina, an address entitled "Some Aspects of Ergodic Theory."

THE eleventh Chapter of Sigma Delta Epsilon, Graduate Women's Scientific Fraternity, was installed at the University of Minnesota on May 26. The installing officer was Dr. Dorothy Day, research associate in the Division of Plant Pathology and Botany of the University of Minnesota, who was national president of the fraternity in 1941 and 1942. The speaker of the evening was Dr. Margaret Sloss, of the department of veterinary pathology of Iowa State College. The local officers for 1945-46 are Jane Leichsenring, professor of nutrition, *President*; Violet Koski, teaching assistant in botany, *First Vice-president*; Kathleen Cummings, research assistant, Dight Institute of Human Genetics, *Second Vice-president*; Eloise Newcomb, teaching assistant in chemistry, *Treasurer*; Agnes Hansen, senior laboratory technologist in the department of botany, *Secretary*.

THE Chicago Dental Society, to encourage continued scientific research in all phases of dentistry, offers a cash prize of \$500 to the author of the most meritorious essay reporting an original investigation and containing new and significant material of value to dentistry. The winner of the award will be invited to present his essay at the eighty-first mid-winter meeting of the Chicago Dental Society to be held next year in February. Application forms and contest rules may be obtained by writing to the Chicago Dental Society, 30 N. Michigan Avenue, Chicago 2, Illinois. All applications must be filed by October 1.

THE compilation of the eighth edition of the National Research Council directory, "Industrial Research Laboratories in the United States," is now under way. The 7th edition appeared in 1940 and contained information concerning the industrial research laboratories of 2,264 companies and their subsidiaries. Although effort was made in 1940 to reach as large a number of laboratories as possible,

SPECIAL ARTICLES

THE HEMOAGGLUTINATIVE PROPERTIES
OF AMNIOTIC FLUID FROM EMBRYO-
NATED EGGS INFECTED WITH
MUMPS VIRUS¹

IN a previous report² it was stated that in spite of many attempts no evidence could be obtained which

¹ These investigations have been carried out as a project of the Commission on Measles and Mumps, Board for the

no doubt some in each field have been inadvertently omitted. It is important that contacts be made with these laboratories in compiling the forthcoming edition. The term "research" for the purpose of the directory is construed as including investigations looking toward the improvement of products or the reduction of cost of manufacture as well as fundamental research and applied research. It does not apply to laboratories concerned only with commercial testing. Research men should inquire of the directors of their laboratories whether questionnaires have been received. If not, one will be sent upon request to the Library, National Research Council. The directory is issued by the National Research Council with no expectation of profit. There is no charge for the inclusion of a statement regarding a laboratory in the publication and no obligation is incurred in furnishing data.

ON June 1, the United States Patent Office put into operation a new service to industry and inventors. Its purpose is to bring to the attention of the nation patented inventions under which the owners are willing to grant licenses on reasonable terms; it is hoped that such information will lead to greater employment opportunities in the reconversion period, as well as to permit industry to become acquainted with what is being done in various fields. To accomplish these purposes a Register of Patents Available for Licensing is now being established, and will be maintained in the United States Patent Office. Patents recorded on this register will be available to the public for inspection in Washington, D. C. Lists of such patents will be published in the *Official Gazette* of the Patent Office.

THE Aluminum Company of America has announced a grant of \$200,000 to the endowment fund of the Carnegie Institute of Technology for the establishment of a professorship of light metals in the department of metallurgical engineering. It is reported that the institute is endeavoring to raise a fund of \$4,000,000 by July 1, 1946, when, if it is successful, the Carnegie Corporation of New York has agreed to contribute \$8,000,000 to the permanent endowment funds of the institution.

indicated that the virus of mumps was capable of multiplication within the tissues of the embryonated hen's egg. Since that time experiments have shown

Investigation and Control of Influenza and other Epidemic Diseases in the Army, Preventive Medicine Service, Office of the Surgeon General, United States Army.

² J. F. Enders, L. W. Kane, S. Cohen and J. H. Levens, *Jour. Exp. Med.*, 81: 93, 1945.

that under certain conditions virus from the gland of the infected monkey may be propagated in this milieu with ease and regularity. The results, which are presented here in a preliminary manner, serve in general to confirm Habel's³ recently published findings.

Habel, however, noted that the yolk sac provided an abundant and reliable source of complement fixing antigen following its inoculation with the virus. Our experience is quite otherwise, since in many instances we have been unable to demonstrate the antigen in that membrane, although it was present in large amounts in other tissues. Moreover, amniotic fluid of infected eggs has been found to agglutinate fowl's erythrocytes in a manner analogous to that of certain other viruses.^{4, 5, 6, 7} This reaction may provide under certain circumstances a diagnostic method more rapid and convenient for detecting increases in antibody concentration than complement fixation.⁸

Fertile eggs which were previously incubated at about 39° C for 6 to 7 days were employed. Demonstration of complement fixing antigen² in the constituents of the egg has been regarded as evidence of infection. Inoculated eggs were incubated at 35° C for 8 or 9 days when the quantity of antigen has been found to be maximal. The original inocula in 4 series of egg passages consisted of saline emulsions of parotid gland from infected monkeys.²

Complement fixing antigen has been demonstrated irregularly in the yolk sac following its inoculation with monkey virus when only a relatively large volume of fluid, *i.e.*, 1 cc, has been used as inoculum. In our previous experiments volumes of inoculum from 0.1 to 0.3 cc were employed. It is possible that these earlier failures in which the yolk sac was studied were in part due to this difference in the physical size of the inocula. The effect of such differences is illustrated in the data included in Table 1.

In contrast to the yolk-sac, as shown in Table 1, the amniotic membrane has with much regularity yielded high concentrations of antigen. Results of titrations of pooled materials from 8 serial passages of the virus inoculated via the yolk sac have also demonstrated the value of the amniotic membrane as a dependable source of antigen and have shown it to be a more sensitive indicator of infection than the yolk sac. Of 28 pools composed of materials

³ K. Habel, *Pub. Health Reports*, 60: 201, 1945.

⁴ G. K. Hirst, *Jour. Exp. Med.*, 75: 49, 1942.

⁵ D. Lush, cited by E. Clark and F. P. O. Nagler, *Austral. Jour. Exp. Biol. and Med. Sci.*, 21: 103, 1943.

⁶ F. M. Burnet, *Austral. Jour. Exp. Biol. and Med. Sci.*, 20: 81, 1942.

⁷ F. P. O. Nagler, *Med. Jour. Austral.*, 1: 281, 1942.

⁸ L. W. Kane and J. F. Enders, *Jour. Exp. Med.*, 81: 137, 1945.

TABLE 1
EFFECT OF VIRUS CONCENTRATION AND SIZE OF INOCULUM
ON THE DEVELOPMENT OF COMPLEMENT-FIXING
ANTIGEN AND ITS DISTRIBUTION IN
EMBRYONATED HEN'S EGGS

C.F. titer Inocula	monk. glands	Vol. inoc. cc	No. eggs pooled	Titer C.F. antigen—1st passage			
				Yolk sac	Amn. membr.	Amn. fluid	Ch. al. membr.
240 (1)		1.0	4	45	600	10	40 0
240		0.1	5	0?	1200	15	40 0
24		1.0	5	180	600	30	75 0
120		1.0	5	0?	600	30	20 0
120		0.1	5	0?	150	30	0? 0
12		1.0	4	0?	300	10wk (2)	0? 0
15		1.0	1	0	300	30	75 0
			3	0	75	10	0 0
15		0.1	4	0	150	30wk	0? 0
			5	0	0	?10wk	0 0

(1) Titers expressed as reciprocals of final dilution of antigen giving "++" or "+++" fixation with at least one of the 2 specimens of antiserum used in tests.

(2) Wk = "++" fixation.

obtained from 107 eggs, 18 yielded amniotic material containing antigen, whereas it could not be detected in the corresponding yolk-sac suspensions. In the remaining 10 pools antigen was found in both the yolk sac and the amnion. The titer of the amnion, however, was in every case significantly greater. Antigen was likewise almost always present in the amniotic fluid, as might be expected in view of the large quantities associated with the amnion. It has not, however, yet been discerned in the chorioallantoic fluid following yolk-sac inoculation, although in some instances it has been found in low concentration in suspensions of the chorioallantoic membrane. The irregularity of its presence here as well as in the yolk sac may have been due to an incomplete separation of the amniotic from other extra-embryonic membranes. Unless great care is taken to separate the amnion from both the yolk sac and the chorioallantois, clearcut results may not be obtained. In a few tests antigen was not detected in the tissues of the embryo itself or in the yolk deprived of the membrane.

A comparative experiment has been done in which yolk-sac virus of the 7th egg passage was inoculated into the amniotic sac, the chorioallantoic sac, the yolk sac, and on to the chorioallantoic membrane. Titrations of the various materials from the eggs inoculated into the 3 sacs gave essentially the same results, *i.e.*, in all instances the amnion yielded the most antigen. On the other hand, the chorioallantoic membrane contained the largest quantity following inoculation onto this tissue. This last observation suggests that under these conditions the chorioallantois may also furnish a reliable and abundant source of antigen.

Although the amount of amniotic membrane ma-

rial obtainable from the egg is small compared with the yolk sac, its high concentration of antigen, its lack of anticomplementary effect and its freedom from the undesirable constituents of the yolk not only appear to render it more suitable as antigen in the complement fixation test, but also characterize it *a priori* as a more suitable material for use in skin testing⁹ and vaccination.¹⁰ These same advantages, together with that of increased yield, would be shared by the chorioallantoic membrane provided further investigation reveals it to be a reliable source of potent antigen.

The infectivity of the amniotic sac material for the egg is considerable. When inoculated via the yolk sac, a suspension of amnion induced infection in dilutions of 10^{-4} and 10^{-6} respectively. A discrepancy was noted in that none of the eggs inoculated with 10^{-5} dilution apparently became infected.

The predilection of mumps virus for the amnion suggests that a similar tropism may be characteristic of other viral agents. So far as we are aware, the capacity of amniotic tissue itself to support the multiplication of virus has been little studied, although the viral content of amniotic fluid has been much investigated. Possibly, therefore, certain viruses which hitherto have not been adapted to the em-

comparable to that usually found in fluids of eggs infected with influenza A. The agglutinative principle operates most efficiently at either room temperature or at 4° C , and at these temperatures is complete at the end of 1 and $1\frac{1}{2}$ hours respectively. At 37° C agglutination is indefinite or the titer is lower. Supernatant fluids from centrifuged suspensions of amnion, chorioallantois and yolk-sac prepared from the same eggs from which the active amniotic fluid was obtained exhibited no definite agglutinative properties. Slight agglutination was noted in the chorioallantoic fluid of the 8th passage. Since the titer of complement-fixing antigen in the amniotic membrane is greater than that of the homologous amniotic fluid, the antigen and the agglutinative factor possibly may be distinct entities. Amniotic fluid, chorioallantoic fluid and suspensions of chorioallantois, yolk-sac and amnion from uninoculated eggs maintained under the same conditions failed to agglutinate red cells.

Hemoagglutination is inhibited by the sera of man and the monkey convalescent from mumps. On the other hand, sera taken during the early stage of the disease in man or from the normal monkey are only slightly inhibitive (Table 3). Rabbit antisera against the viruses of influenza A and B did not significantly inhibit the agglutination. Accordingly, the hemo-

TABLE 2
AGGLUTINATION OF HEN'S ERYTHROCYTES BY AMNIOTIC FLUID FROM EGGS INFECTED WITH MUMPS VIRUS

Amniotic fluid	Dilution of amniotic fluid									
	4(1)	8	16	32	64	128	256	512	1,024	2,048
7th passage	+++ ⁽²⁾	+++	+++	+++	+++	+++	++	++	+	nd(3)
8th passage	nd	nd	nd	+++	+++	+++	+++	++	+	0
Normal	0	0	0	0	0	nd	nd	nd	nd	nd

(1) Reciprocal of final dilution of amniotic fluid.

(2) Degree of agglutination as read by comparison with Hirst's standard r.b.c. suspensions.

(3) Not done.

ryonated egg may be found to multiply within this structure.

It was noted that embryonic erythrocytes included by chance in a pool of amniotic fluid from the 7th passage of mumps virus showed a tendency to clump on standing at room temperature for one half hour. Accordingly, an experiment was done, employing Hirst's technique,⁴ to determine whether amniotic fluid of the 7th and 8th serial passages contained a hemoagglutinative factor.

The results presented in Table 2 show that this fluid was indeed agglutinative for fowl's corpuscles and that the concentration of the mumps factor was

agglutinative factor is not to be identified with the influenza viruses which are also being studied in this laboratory. Hemoagglutination by amniotic fluid, then, seems specifically dependent upon infection with the virus of mumps.

Earlier experiments² in which monkey-gland virus was mixed with suspensions of the red cells of many of the common domestic animals and man gave no indication of hemoagglutination. The failure of the monkey virus to cause agglutination, although the titer of complement fixing antigen may be high, has been recently confirmed in this laboratory. Apparently, therefore, this attribute becomes manifest following adaptation to the egg. To determine whether or not the virus is hemoagglutinative during the earliest passages in the egg or whether the property

⁹ J. F. Enders, S. Cohen and L. W. Kane, *Jour. Exp. Med.*, 81: 119, 1945.

¹⁰ J. Stokes, Jr., J. F. Enders, E. P. Maris and L. W. Kane, *Am. Jour. Dis. Child.*, 69: 327, 1945.

TABLE 3
INHIBITION OF HEMOAGGLUTINATION BY HUMAN AND SIMIAN CONVALESCENT MUMPS SERUM

	Dilution of serum											Virus control
	4(1)	8	16	32	64	128	256	512	1,024	2,048		
Conval. monk.	(4)	0	0	0	0	0	tr?	nd(3)	nd	nd	nd	+++
Normal monk.	(4)	+(2)	++	+++	+++	+++	+++	+++	+++	+++	+++	+++
Conval. human	(5)	nd	0	0	++	++	+++	+++	+++	+++	nd	+++
Before dis.	(5)	nd	++	+++	+++	+++	+++	+++	+++	nd	nd	nd
Conval. human	(6)	nd	0	0	0	+	+	+	++	++	nd	nd
Acute human	(6)	nd	+++	+++	+++	+++	+++	+++	nd	nd	nd	nd

(1) Reciprocal of final dilution of serum.

(2) Cf. table 2, footnote 2.

(3) Cf. table 2, footnote 3.

(4) Sera from different monkeys.

(5) Sera from same individual; one specimen taken before exposure to mumps; the convalescent 7 days after onset of symptoms.

(6) Sera from same individual; convalescent specimen taken 15 days after onset.

is only gradually acquired must await further experimentation.

JEANETTE H. LEVENS
JOHN F. ENDERS

DEPARTMENT OF BACTERIOLOGY AND
IMMUNOLOGY,
HARVARD MEDICAL SCHOOL AND
SCHOOL OF PUBLIC HEALTH,
BOSTON, MASS.

DISTRIBUTION OF RADIOACTIVE ARSENIC
FOLLOWING INTRAPERITONEAL INJECTION
OF SODIUM ARSENITE INTO
COTTON RATS INFECTED WITH
LITOMOSOIDES CARINII¹

INTRODUCTION

IT has been shown^{2, 3} that adult *Dirofilaria immitis* in naturally infected dogs show a specific uptake of antimony following treatment with trivalent antimony compounds. These adult parasites appeared to be normal at the autopsies of the treated dogs, but microscopic examination of the uteri by Ashburn *et al.*⁴ revealed significant alteration of the ovaries and uterine contents.

We have found⁵ that the adult filarids of dogs have a specific uptake for trivalent arsenic as reported for the trivalent antimony. Having established the fact that both antimony and arsenic in the trivalent form were localized in the adult filarids of dogs in concentrations greater than the majority of the tissues of the hosts and certainly greater than the concentration gradient of the blood, it was believed impor-

¹ From the Zoology and Chemistry Laboratories, National Institute of Health, and the Department of Terrestrial Magnetism, Carnegie Institution of Washington.

² Frederick J. Brady, Alfred H. Lawton, Dean B. Cowie, Howard L. Andrews, A. T. Ness and Glen E. Ogden, *Am. Jour. Trop. Med.*, 25(2): 103-107, 1945.

³ Dean B. Cowie, Alfred H. Lawton, A. T. Ness, Frederick J. Brady and Glen E. Ogden, *Jour. Wash. Academy Sci.*, 35(6): 192-195, 1945.

⁴ L. L. Ashburn, T. Perrin, Frederick J. Brady, Alfred H. Lawton (in press, *Arch. Path.*).

⁵ Unpublished data.

tant to ascertain if the actual location of the parasite in the host would be a factor in this specific uptake. The adult *Litomosoides carinii* are in the pleural cavity, whereas the adult *Dirofilaria immitis* are in the right side of the heart.

METHODS

The radioactive arsenic was prepared by the bombardment of germanium metal with deuterons in the 60-inch cyclotron at the Department of Terrestrial Magnetism, Carnegie Institution of Washington. This arsenic had a sufficiently long half life (16 days) to enable great precision to be obtained in the final measurements.

A chemical separation of the arsenic from the other radioactive and non-radioactive contaminants was made by a procedure recently described by Ness.⁶ The arsenic was converted to sodium arsenite, $NaAsO_2$, as outlined in the above reference. Six cotton rats naturally infected with *Litomosoides carinii* were injected intraperitoneally with 1.6 milligrams of arsenic, as sodium arsenite, per kilogram of body weight. Twenty-four hours later the animals were sacrificed and twelve tissues removed, carefully weighed, and then dried *in vacuo* over phosphorus pentoxide. After sixteen hours of drying, the tissues were re-weighed, ground, and the arsenic content determined by means of suitable Geiger-counters, sealing and counting circuits. Each sample was measured in a lucite cup of standard dimensions, each cup being carefully tested for radioactive contamination before being used and no cup was used twice during any experiment. Conversion of the counting data for each determination of the radioactive samples to micrograms of arsenic was made by preparing from the solution of sodium arsenite to be injected a standard solution containing one microgram of arsenic per milliliter. This was treated in the same manner as the unknown tissue

⁶ A. T. Ness, "Separation of Radioactive Arsenic from Copper and Germanium" (in manuscript).

samples and sufficient counts were taken for all samples to insure an accuracy better than 1 per cent. Whenever possible, equal amounts of all the dried samples were measured for radioactivity at a standard distance from the counter to maintain rigid uniformity in the measuring techniques. Since the average dry weights of the various tissues studied were

knowledge that arsenic can be eliminated by the epidermis.⁷ Rather significant is the extremely low level of concentration found in the dermis relative to the high concentration of the epidermis. In fact it appeared that the dermis reflected the blood concentration while the epidermis was on an average about five times greater.

TABLE 1

ARSENIC CONCENTRATION OF TISSUES OF SIX COTTON RATS TWENTY-FOUR HOURS AFTER THE INTRAPERITONEAL INJECTION OF 1.6 MILLIGRAMS OF ARSENIC PER KILOGRAM OF BODY WEIGHT AS SODIUM ARSENITE

Tissue	Micrograms arsenic per gram wet wt. of tissue	Tissue	Micrograms arsenic per gram wet wt. of tissue	Tissue	Micrograms arsenic per gram wet wt. of tissue
Cotton Rat 46		Cotton Rat 49		Cotton Rat 50	
Adult Filarids	1.310	Liver	2.62	Adult Filarids	1.65
Kidney	1.044	Epidermis	1.93	Liver	1.59
Liver	1.022	Adult Filarids	1.83	Kidney	1.53
Lung	0.918	Spleen	1.51	Epidermis	0.956
Spleen	0.753	Lung	1.34	Lung	0.833
Epidermis	0.549	Kidney	1.29	Muscle	0.791
Muscle	0.475	Blood	0.989	Spleen	0.667
Heart	0.422	Muscle	0.866	Heart	0.411
Dermis	0.320	Heart	0.842	Thyroid	0.199
Thyroid	0.267	Thyroid	0.585	Blood	0.196
Blood	0.207	Dermis	0.401	Dermis	0.196
Brain	0.172	Brain	0.299	Brain	0.196
Cotton Rat 51		Cotton Rat 27		Cotton Rat 28	
Adult Filarids	1.738	Kidney	1.566	Kidney	1.791
Kidney	1.18	Spleen	0.879	Spleen	1.484
Epidermis	1.16	Adult Filarids	0.874	Epidermis	1.016
Liver	0.841	Liver	0.775	Liver	0.978
Lung	0.695	Epidermis	0.654	Lung	0.478
Spleen	0.466	Lung	0.593	Muscle	0.440
Muscle	0.352	Thyroid	0.586	Heart	0.345
Heart	0.340	Heart	0.332	Dermis	0.267
Blood	0.180	Muscle	0.285	Blood	0.264
Dermis	0.131	Dermis	0.266	Adult Filarids	0.214
Brain	0.123	Brain	0.201	Brain	0.176
Thyroid	0.000	Blood	0.169	Thyroid	0.000

about 25 per cent. of the wet weights, and equal quantities of the tissues were measured, self-absorption of the radiation by the sample material was considered to be constant and equal for all samples. For the final calculations, individual corrections were necessary for the per cent. of water lost during the drying. No radioactivity was detected in the phosphorus pentoxide after the drying process, indicating no loss of the arsenic during this procedure.

RESULTS

The arsenic concentration of twelve tissues from each rat twenty-four hours after injection is given in Table 1 in terms of micrograms of arsenic per gram wet weight of tissue. In three of the rats, the adult filarids had the highest concentration of the tissues studied. The filarids in two other rats had the third highest concentration, while in rat No. 28 the adult filarids showed no specific uptake. Rat No. 28 was an old animal with a marked chronic fibrous pleuritis which was not found in any of the other rats.

Contrary to the findings in dogs treated with antimony, the cotton rat thyroid showed no specific uptake of arsenic. The epidermis was found to have a high concentration. This is in agreement with the

Figure 1 is a histogram of the average arsenic concentration in micrograms per gram of wet weight of the tissues shown in Table 1. If the data on rat No. 28 were eliminated from these averages, the adult filarids would contain the highest concentration of arsenic instead of containing the third highest.

DISCUSSION

The high concentration of the kidney and liver are not surprising. It is well known that arsenic is eliminated in urine and bile. The kidney cortex, liver, epidermis, spleen and lung may be said to show a specific uptake of arsenic. Although the dermis does not appear in this list, the appearance of the epidermis here would suggest that trivalent arsenical compounds might offer more promise in the treatment of *Onchocerca volvulus* than antimonial compounds which showed no specific affinity for either dermis or epidermis.

Lymph nodes showed no specific affinity for either trivalent arsenic or antimony. However, this should not eliminate studies on the usefulness of these elements in treating *Wuchereria bancrofti* infection as the filarids residing in the lymph nodes may be able

⁷ A. Heffter, *Arch. Internat. Pharm. et Therapie*, 15: 399-417.

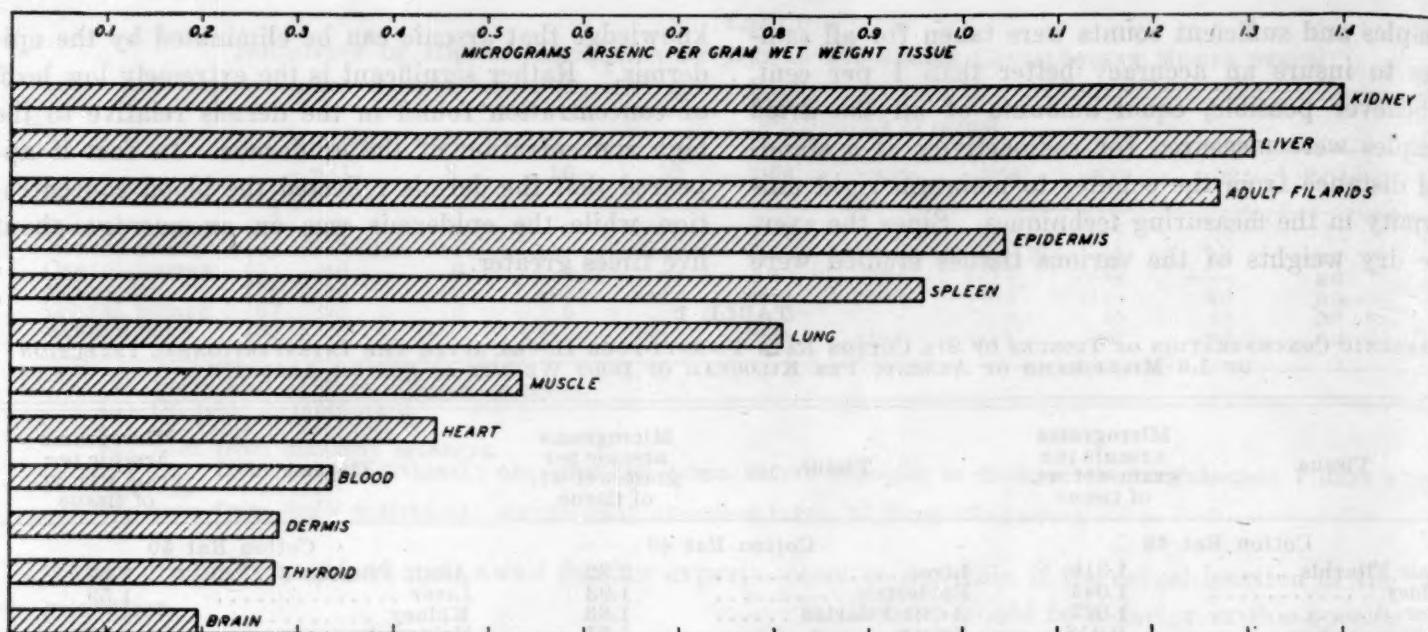


FIG. 1. Average arsenic concentrations of tissues of six cotton rats twenty-four hours after the intraperitoneal injection of 1.6 milligrams of arsenic per kilogram of body weight as sodium arsenite.

to take up sufficient quantities of the elements from the lymph to prove damaging to themselves. The fact that *Dirofilaria immitis* and *Litomosoides carinii* both showed specific affinity for arsenic makes such a hypothesis tenable.

In spite of the fact that *Litomosoides carinii* live in the pleural space, they showed a specific uptake of trivalent arsenic in five of the six cotton rats studied. Although the filarids in the sixth cotton rat appeared to be normal, they showed no specific uptake of the arsenic. In this rat, the only factor apparent to explain this difference was the presence of a chronic fibrous pleuritis. Such results suggest that treatment in human filarial infections might be more efficacious in early stages of the disease before the formation of extensive scar tissue.

CONCLUSIONS

Adult *Litomosoides carinii* of five of six infected cotton rats showed a specific affinity for arsenic after the injection of sodium arsenite. Lack of uptake in the sixth rat is attributed to the presence of a fibrous pleurisy. A specific localization of arsenic was shown in kidney cortex, liver, epidermis, spleen and lung of cotton rats.

ALFRED H. LAWTON

A. T. NESS

FREDERICK J. BRADY

DEAN B. COWIE

SYNERGISTIC ACTION BETWEEN SULPHONAMIDES AND CERTAIN DYES AGAINST GRAM-NEGATIVE BACTERIA

As one of a number of possible explanations of the mode of action of substances that inhibit cell divi-

sion of bacteria Henry¹ has suggested that the bacteriostatic agent may "poise" the oxidation-reduction potential in the immediate environment of the cell at a level which will preclude the normal functioning of one or more desmolytic enzyme systems.

Ingraham² has presented evidence in support of this hypothesis with respect to bacteriostatic dyes, a similar concept having been previously propounded by Dubos.³ Henry¹ has indicated that inhibition of dehydrogenases by sulphonamides may, in part, be due to such a mechanism. More recently, Michaelis and Thatcher⁴ have shown that the antibiotic substance, citrinin, depresses the action of certain desmolytic enzymes of susceptible species. These last workers also (unpublished) investigated the possibility of augmenting the "poising" effect of antibiotic substances by the addition of dyes of known E'o values. Various dyes brought about bacteriostasis, but a synergistic effect was not disclosed either between combinations of dyes or between dyes and citrinin.

The work of Soo-Hoo and Schnitzer,⁵ however, confirms Ungar⁶ in that a synergistic action does exist between penicillin and sulphonamides. Similar studies were therefore undertaken with sulphonamides and eH indicator dyes with respect to their activity against both *Staphylococcus aureus* and *Escherichia coli*.

It became immediately apparent that a pronounced synergistic effect was manifest, as is indicated by comparison of Tables 1 and 2. Moreover, the sulphonamides, which normally have little if any effect against

¹ *Bact. Rev.*, 7(4): 175-262, 1943.

² *Jour. Bact.*, 26: 573-598, 1933.

³ *Jour. Exp. Med.*, 49: 575-592, 1929.

⁴ *Can. Jour. Res.* (in press).

⁵ *Arch. Biochem.*, 5: 99-106, 1944.

⁶ *Nature*, 152: 245, 1943.

Gram-negative bacteria, would, in the presence of 1:28,000 methylene blue or brilliant cresyl blue, completely inactivate 10 million cells of a 24-hour cul-

TABLE 1
THE CONCENTRATIONS OF INDIVIDUAL DYES AND SULFONAMIDES REQUIRED TO KILL 10^7 CELLS OF *E. coli* OR *Staph. aureus* IN 10 CC NUTRIENT BROTH BUFFERED AT PH 6.8, INCUBATED AT 37° C.

Reagent	Concentration	
	<i>Staph. aureus</i>	<i>E. coli</i>
Methylene blue	1:100,000	1:13,000
Brilliant cresyl blue	1:130,000	1:20,000
Sulfathiazole	1:100	complete bacteriostasis not apparent at saturation levels
Sulfapyridine	1:100	
Sulfanilamide	1:100	
Sodium sulfathiazole	1:100	

ture of *E. coli* in 10 cc of nutrient broth buffered at pH 6.8 and containing a final concentration of 1:14,000 sulfapyridine, sulfathiazole or sodium sulfathiazole.

TABLE 2
THE CONCENTRATION OF METHYLENE BLUE OR BRILLIANT CRESYL BLUE REQUIRED TO KILL 10^7 CELLS OF *E. coli* IN 10 CC NUTRIENT BROTH BUFFERED AT PH 6.8 IN THE PRESENCE OF SULFONAMIDES AT 1:14,000

Sulfonamide	Methylene blue	Brilliant cresyl blue
Sulfathiazole	1:28,000	1:32,000
Sulfapyridine	1:28,000	1:28,000
Sulfanilamide	1:18,000	1:18,000
Sodium sulfathiazole	1:28,000	1:32,000

Clinical studies undertaken in cooperation with Dr. J. T. MacLean at the Ste. Anne de Bellevue Military Hospital indicate a promising therapeutical value for the combination of sulfathiazole and methylene blue in the treatment of chronic genito-urinary infections by Gram-negative bacteria.

F. S. THATCHER

MACDONALD COLLEGE,
MCGILL UNIVERSITY

ACID PHOSPHATASE IN GROWING AXONS AND DEGENERATED NERVE TISSUE

WOLF, Kabat and Newman¹ have reported the presence of acid phosphatase in the axis-cylinders of both the peripheral and central nervous system. The myelin sheaths appear to be devoid of the enzyme. Since phosphatase has been implicated in the metabolism of both phospholipids and sugars, it would appear that studies on this enzyme might give an indication of some of the metabolic processes going on within the nerve fiber and specifically in the axonal portion. This preliminary report deals with the results obtained from the study of (1) the growing

¹ A. Wolf, E. A. Kabat and W. Newman, *Am. Jour. Path.*, 19: 423, 1943.

nerve fibers of the cat from birth to neurologic maturity and (2) the behavior of the enzyme in the degenerating neuron.

It was found necessary to make considerable change in the existing technics for demonstration of acid phosphatase as applied to the tissue of the central nervous system. The method used, as well as a more complete description of our observations, will be published elsewhere.

Studies of the growing neuron have been made on cats of the following ages: 1, 2, 5, 10, 15, 20, 70 days and adult. The evidence from this series indicates that variations in the time of appearance of the enzyme in the axons are to be correlated with the phylogenetic background of the several nerve tracts as well as the ontogenetic age of the animal. Thus, at birth the ventral and dorsal roots, the sensory tracts within the cord, the medial longitudinal fasciculus and tecto-spinal tracts in the brain stem all give a marked positive reaction. At this age, the higher brain centers, as well as the great motor bundle, the pyramidal tract, show comparatively little or no phosphatase. Likewise, the tracts which react positively are known to be the first to become myelinated. In the later postnatal stages, a progressive increase in the reaction occurs in the higher brain centers. Comparatively, the pyramidal tract gives an incomplete reaction until some time after the 70th day. Thus, if the presence of acid phosphatase indicates a functional state in nerve conduction it would appear that the neuronal elements concerned with the cord and brain-stem reflexes are the first to show the presence of the enzyme.

Studies on the degenerating neuron have been made on the pyramidal tract in cats and monkeys following removal of the motor cortex. This bundle, in two monkeys with a post-operative survival time of four and five months, can be traced with ease from the cortex to the sacral cord segments. The entire degenerating field gives a marked acid phosphatase reaction. Since, in this breakdown, the affected axis-cylinders have disappeared the phosphatase must be associated with the glial tissue and possibly with chemical remnants of the myelin sheaths. One of the fundamental and unanswered questions in the field of neurology and neuropathology is why the medullated membrane should degenerate concurrently with the axis-cylinder when the cell body or nerve fiber is seriously damaged. There is the distinct possibility, on the basis of the present study, that the axon may liberate a substance (enzyme) which acts on the myelin sheath in a manner to cause its disintegration. Studies are in progress to determine the immediate or acute secondary and retrograde changes in phosphatase following injury to the neuron.

Two cats, similarly treated as the monkeys, but

with a six months' survival time, give a negative reaction in the degenerating area. This finding, in contrast to the monkey, possibly has its explanation in its being either a more chronic preparation or more likely on the basis of an augmented metabolic rate which results in the complete assimilation of the degenerating neuron.

In conclusion, we feel that studies on acid phosphatase in the nervous system open up possibilities in the field of neuronal metabolism and function and that an additional method is offered for demonstrating both normal and degenerated nerve tissue.

A. M. LASSEK

WALTER L. HARD

DEPARTMENT OF ANATOMY,
MEDICAL COLLEGE OF THE STATE OF SOUTH CAROLINA

PRECOCIOUS GONAD DEVELOPMENT IN OYSTERS INDUCED IN MIDWINTER BY HIGH TEMPERATURE

SPAWNING of the American oyster, *Ostrea virginica*, of Long Island Sound and the adjacent geographical areas of the North Atlantic Coast begins late in June or early July and is usually completed late in August or early in September.¹ After resorption of the undischarged sex cells the gonads of the oysters pass through the indifferent stage, when the sexes are undistinguishable, the sex differentiation stage, when slight gametogenic activities occur, and then enter into the winter, or inactive stage, which persists until April or, in some individuals, until May.² During the inactive stage the gonad follicles are small, containing only the cells of the early stages of gametogenesis. Seasonal gonadal changes of many other pelecypods closely resemble those of *O. virginica*.³

Since the period during which the oysters contain morphologically and physiologically ripe gametes is relatively short in northern localities, the time which could be devoted to the study of these cells or to observations on the development, growth and physiology of the larvae is correspondingly limited. Therefore, if oysters could be induced to develop gametes at periods other than the summer time, additional opportunities would be available for investigations in the field of embryology and in that of the biology of oyster larvae.

The literature contains numerous references on precocious gonad development in many species of animals induced by artificial changes in the external or internal environment. This out-of-season gonad development may be caused by changing the physical

¹ V. L. Loosanoff and J. B. Engle, *Biol. Bull.*, 82: 413-422, 1942.

² V. L. Loosanoff, *Biol. Bull.*, 82: 195-206, 1942.

³ W. R. Coe, *Quarterly Review of Biology*, 18: 154-164, 1943.

factors, such as the relative length and the intensity of illumination, changes in temperature, or by employing chemical methods, such as injection of hormones, or changes in food. A review of the literature on these subjects is not, however, in the scope of this article, the purpose of which is merely to suggest a method which would provide laboratory workers with active spermatozoa and fertilizable oyster eggs during the winter and early spring months.

The present experiments were conducted from the end of November to the middle of March. The oysters were taken from the outdoor tanks, where the water temperature was near the freezing point and usually a layer of ice was formed over the surface. Examination of samples of the tank oysters revealed that their gonads were in a typical winter or inactive stage.

To avoid the effects of sharp changes in temperature, which would occur if the hibernating oysters were changed directly from ice-cold water to that of 20° C. or above, the necessary precautions were observed. The animals brought in from outside were placed in the aquaria filled with water the temperature of which was the same as that at which the oysters were kept before being taken into the laboratory. Within 24 hours the water in the aquaria usually reached room temperature. After keeping the animals under such a condition for 48 or 72 hours the temperature was slowly brought to the desired level and maintained there by thermostats throughout the experiment. The temperatures to which the different groups of oysters were exposed were 20°, 25° and 30° C. The fluctuations in the temperatures were within $\pm 1.5^{\circ}$ C. of the above given figures. A direct transfer from cold water to that of 30° C. appeared to injure some of the oysters and sometimes caused their death.

Examination of the oysters kept at a temperature of 20° C. for 20 days showed that some of them had developed a large number of eggs during that period. Active spermatozoa were also observed in a few individuals. Nevertheless, the majority of the oysters appeared unripe. After 30 days, however, the animals were in a much more advanced condition and many individuals possessed well-developed eggs or active spermatozoa.

Oysters kept for one month at temperatures of 25° or 30° C. formed a gonadal layer the thickness of which in some cases was 3.5 mm, thus comparing favorably with the animals developing their gonads in the summer time under natural conditions.¹ The eggs of the experimental oysters were carefully removed from the follicles and placed in sea water to which spermatozoa were added. Fertilization occurred and zygotes proceeded to develop into larvae, which were kept alive for several days and appeared normal in their form and behavior.

An additional interesting observation made in the course of these studies was that the oysters had developed gametes regardless of the fact that the mollusks were kept under comparatively unfavorable conditions. The water in the aquaria, although aerated, was changed only once every 7 or 10 days. At the time of the change a small quantity of food was added. It was quickly consumed by the oysters; thus, with the exception of brief periods, the animals were virtually deprived of food. These observations may indicate, therefore, that the apparently normal development of the oyster gonads may proceed when the quantity of food is rather limited.

Undoubtedly, the method described in this article, or its modifications, may be successfully applied to

certain pelecypods other than *O. virginica*. Through recent personal communication with Mr. D. L. McKernan and Dr. Vance Tartar, of the State of Washington Oyster Laboratory at Gig Harbor, Washington, I was advised that they also repeatedly succeeded in inducing a larviporous species of oyster, *O. lurida*, to release larvae in midwinter by keeping the animals in warm sea water.

I wish to express my appreciation to Mr. Charles Nomejko and Miss Frances Tommers for their assistance in this work.

VICTOR L. LOOSANOFF

FISHERY BIOLOGICAL LABORATORY,

U. S. FISH AND WILDLIFE SERVICE,
MILFORD, CONN.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

AN APPLICATION OF THE LYOPHILE PROCESS TO THE MAINTENANCE OF CULTURES FOR MICROBIOLOGICAL ASSAY¹

WHILE the lyophile process of desiccation from the frozen state has long been employed by bacteriologists for the preservation of cultures, there appears to have been no application of this method to the maintenance of highly viable cultures for use in the microbiological assay of vitamins and amino acids. It is a common experience in many laboratories that there is a gradual departure in linearity of response and activity of cultures of *Lactobacillus arabinosus* and *Lactobacillus casei* transferred at monthly intervals from one agar stab to another. In a search for a means of obtaining more constant standard curves and of obviating the frequent transfer of the culture organisms in order to maintain them in optimum condition for acid production, experiments were carried out to determine whether or not this could be successfully accomplished by lyophilizing the cultures.

Thus far, results have shown that *L. arabinosus* 17-5 and *L. casei* ϵ cultures maintain their activity when lyophilized by a simple procedure (*cf.* Table 1 and Fig. 1). After three months' storage such cultures gave equally as good response as did the standard culture maintained by weekly transfer through broth² to liver tryptone agar. Since these cultures have been stored without decreased activity for three

months and are completely desiccated and sealed under high vacuum, they presumably will maintain their activity for a much longer period. It should be feasible then to lyophilize a six months' or year's supply of cultures at one time. This procedure would be especially advantageous for laboratories where microbiological assays are carried out only infrequently or on a seasonal schedule.

TABLE 1
A COMPARISON OF THE ACID PRODUCTION OF STANDARD AND LYOPHILIZED CULTURES OF *Lactobacillus casei* ϵ *

Micrograms riboflavin	72-hour lactic acid production (ml N/10 KOH)			
	One month	Two months	One month	Two months
0	0.99	1.02	1.00	0.99
0.05	4.95	4.99	4.82	4.84
0.1	8.11	8.44	8.02	8.41
0.15	10.32	10.81	10.53	10.76
0.2	12.25	12.90	11.75	13.17
0.25	13.84	14.16	13.08	13.84
0.3	14.52	14.94	13.23	15.08

* Basal medium of Snell and Strong (*Ind. Eng. Chem. Anal. Ed.*, 11: 346, 1939) modified to contain 2 per cent. glucose and 2 per cent. sodium acetate.

The lyophile process used in our laboratories requires no special equipment and could be accomplished in any laboratory at very little cost. The procedure is as follows: Cultures of *L. arabinosus* and *L. casei* are grown for 24 to 36 hours at 30° C. and 37° C., respectively, in a nutrient-rich medium.² These cultures are then centrifuged, and to the cells

¹ Aided by a grant from the Consolidated Edison Company of New York, Inc. Received for publication, February 19, 1945.

² We have used the following medium: 1 per cent tryptone; 0.5 per cent K_2HPO_4 ; 0.2 per cent glucose; 0.2 per cent yeast extract (Difco); 10 per cent fresh liver extract (1 pound ground liver per 2 l. water. Steam 60 minutes. Filter through cheesecloth. Neutralize to pH 7.0. Heat 15 minutes. Filter through coarse filter paper.)

obtained from 10 ml of broth is added $\frac{1}{2}$ ml of sterile skim milk. One-tenth ml quantities of this milk suspension are added to sterile, cotton-plugged, straight-sided specimen vials (10 mm \times 42 mm). A narrow strip of cellulose tape is placed over the cotton plug to assure its remaining in position. The vials are then placed in a desiccator containing Drierite (anhydrous CaSO_4) and lyophilized by holding under vacuum over night. If a pump such as the Cenco Hyvac is used, the contents are quickly frozen and after desiccation yield a white fluffy powder which readily forms a suspension upon the addition of liquid. With a lower vacuum a dark, resinous mass occurs which forms a suspension only after a considerably longer period of time. Although cultures of *L. arabinosus* dried under low vacuum have given results after three months that were comparable to

cultures are stored at room temperature away from the light.

For the preparation of the inoculum a desiccated culture is suspended in about one ml of sterile saline or basal medium, and after being stirred by means of a sterile inoculation needle the entire content of the vial is added to 20 ml of diluted basal medium containing the vitamin or amino acid to be assayed (for example, 0.3 μg niacin or riboflavin) and is incubated the customary 24 to 36 hours prior to use. Lyophilized cultures of *L. arabinosus* suspended in 10 ml of saline and used directly as inoculum for assay procedure did not produce as much acid in 72 hours as did the inoculum incubated before use. The response was as linear, however. A comparison of the acid production of standard cultures and of incubated and non-incubated lyophilized cultures of *L. arabinosus* stored two months is shown in Fig. 1.

Further storage studies are in progress and will be reported at a later date. It is felt that the lyophile process as applied to these microbiological assay organisms is saving of time, labor and culture materials, since it obviates the preparation of agar stabs and broths and also the frequent transfer of the cultures necessary to maintain highly viable cells. It also improves the reproducibility of the assay curves in so far as they are influenced by the bacterial cultures.

MAVIS C. NYMON
I. C. GUNSAULUS
W. A. GORTNER

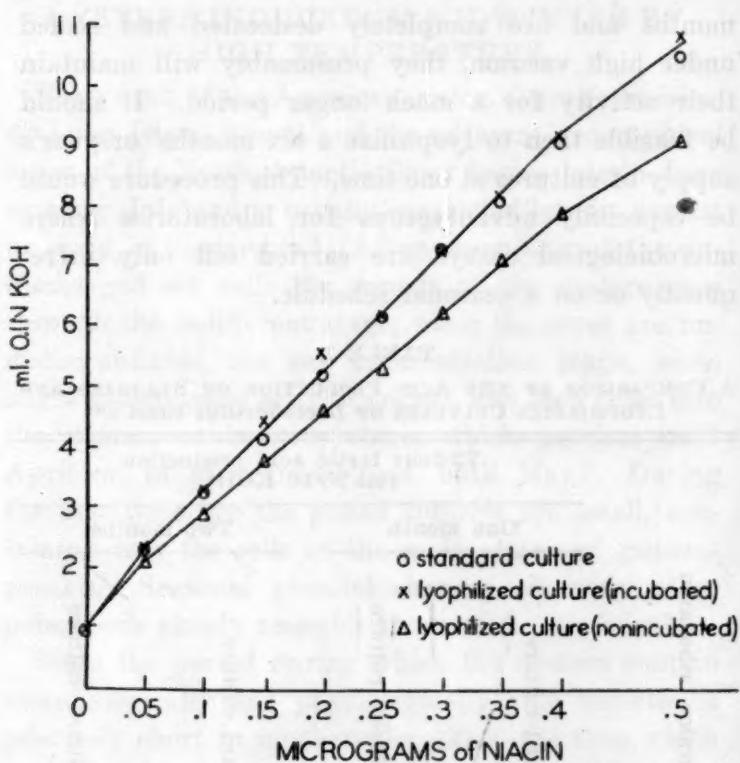


FIG. 1. A comparison of the 72-hour acid production of standard cultures and incubated and nonincubated lyophilized cultures of *Lactobacillus arabinosus* 17-5 in response to added niacin, employing the basal medium of Krehl, Strong and Elvehjem (*Ind. Eng. Chem., Anal. Ed.*, 15: 471, 1943). The lyophilized cultures had been stored two months.

cultures lyophilized by high vacuum, cultures of *L. casei* did not seem as viable when the lower vacuum was used. For best results one should employ high vacuum.

After the contents of the vials are dry (12-18 hours under vacuum), the vials are placed in $\frac{1}{4}$ inch test-tubes, which are then constricted in an oxygen flame. The tubes are evacuated by means of a high vacuum pump and sealed by rotating in a Fisher burner. The

FOLLOWING the initial isolation of a bacteria-free strain of *Trichomonas vaginalis* by Trussell² in June, 1939, various investigations of the pathogenicity,³ physiology^{4,5,6,7,8,9,10,11,12} and chemotherapy^{13,14} of

¹ Aided by a grant from The Ortho Research Foundation.

² Ray E. Trussell, *Jour. Iowa State Med. Soc.*, 30: 66, 1940.

³ Ray E. Trussell and E. D. Plass, *Am. Jour. Obst. and Gynec.*, 40: 883, 1940.

⁴ Garth Johnson, *Proc. Soc. Exp. Biol. and Med.*, 45: 567, 1940.

⁵ Alfred B. Kupferberg, *Proc. Soc. Exp. Biol. and Med.*, 45: 220, 1940.

⁶ S. H. McNutt and Ray E. Trussell, *Proc. Soc. Exp. Biol. and Med.*, 46: 489, 1941.

⁷ Ray E. Trussell and Garth Johnson, *Proc. Soc. Exp. Biol. and Med.*, 47: 176, 1941.

⁸ Ray E. Trussell and S. H. McNutt, *Jour. Inf. Dis.*, 69: 18, 1941.

⁹ A. B. Kupferberg and Garth Johnson, *Proc. Soc. Exp. Biol. and Med.*, 48: 516, 1941.

this parasite have been carried out in this laboratory. The desirability of obtaining other bacteria-free strains was early realized, but several attempts have uniformly resulted in failure. Consequently, it has been impossible to attack certain problems dealing with antigenic differences, variations in pathogenicity, physiology and growth requirements among strains.

It was recently decided to try the use of penicillin to sterilize new strains. The chances of success were known to be limited because of the reported resistance of many bacterial species to the action of this drug. For this reason, combinations of penicillin with tyrothricin and sulfathiazole offered additional theoretic possibilities.

Seven women with acute or subacute trichomonas vaginitis served as donors of vaginal discharge.¹⁵ Only two of these infestations had received treatment prior to collection of the material. Both had proved resistant to the usual forms of therapy and had persisted for many months. The other five infestations were of unknown duration. The character of the associated bacterial flora was undetermined except for the last donor, who was diabetic and was found to harbor both yeast-like fungi and B-hemolytic streptococci. Each of these women became the source of one experimental strain and the seven strains were collected in the course of six weeks.

The penicillin was obtained from the residual fluid in bottles discarded after clinical administration. The stoppers were treated with 70 per cent. alcohol for ten minutes. Approximately 8 ml of sterile C.P.L.M. medium¹⁸ were introduced by sterile syringe. The contents were mixed and then withdrawn and discharged into a sterile culture tube. The resulting culture fluid was estimated to contain 500 to 1,000 units of penicillin per ml.

Two loops of vaginal discharge obtained by speculum from a given patient were introduced into each of two culture tubes, and the cultures were incubated for sixty hours at 35° to 37° C. Microscopic examination then showed a high trichomonas population.

The first transfers were made into straight C.P.L.M. medium without penicillin. Good cultures were obtained after 72 to 96 hours incubation at 37° C. An additional transfer into the basic medium plus peni-

cillin was tried in one instance. This second culture in the medium with penicillin showed no growth. The exact reason for this is not determined, but it may be significant that this particular sample of penicillin contained adrenalin. Subsequently the contact time with penicillin was limited to 60 hours' incubation without an intervening transfer.

Further transfers were made from the penicillin-treated organisms into C.P.L.M. medium at 40- to 44-hour intervals. In contrast to Trussell's strain, these seven strains of trichomonads tended to grow in clumps when first isolated. This characteristic was found to persist for four to six weeks with gradual diminution. They finally assumed the un-clumped character of Trussell's strain, which had been in culture for six years. Stained preparations revealed a typical morphology.

At the time of the first and second transfers the following media were inoculated to test for the presence of contaminating bacteria: B.B.L. thioglycollate with added dextrose, tomato juice agar (pH 5), blood agar, chocolate agar, nutrient agar, eosin methylene blue agar, selenite F broth, glycerol bile peptone broth, deep meat tubes, deep agar inoculations, 4 per cent. glucose agar, tellurite agar, nutrient broth and blood agar plate in a McIntosh Fildes anaerobic jar. No evidence of bacterial contamination was obtained with any of these media. All subsequent cultures of the seven strains have been tested with the thioglycollate medium. To date, none has given evidence of the presence of either aerobic or anaerobic bacteria.

Combination of penicillin with 100 mg of sulfathiazole per culture tube failed to show any advantage over penicillin alone. A like amount of tyrothricin with penicillin proved lethal to the trichomonads. The use of penicillin alone was accepted as the method of choice.

SUMMARY

Exposure of *Trichomonas vaginalis* in vaginal discharge for 60 hours to 5,000-10,000 units of penicillin in 10.0 ml of a medium containing cysteine (0.15 per cent.), peptone, liver infusion, maltose and human serum was adequate to destroy the associated bacteria. Seven strains were isolated from seven women without a failure. This technic widens the field of investigation by offering a means of obtaining additional strains of bacteria-free *Trichomonas vaginalis* for comparative study.

Efforts to isolate *Trichomonas vaginalis* by such laborious methods as washing, micropipetting and migration have all failed to yield bacteria-free cultures at this and other laboratories. The adherence of bacteria to the trichomonads, which appear to have sticky surfaces, and the relatively slow speed with which these protozoa swim are probably in large

¹⁰ Ray E. Trussell, Mary E. Wilson, et al., *Am. Jour. Obst. and Gynec.*, 44: 292, 1942.

¹¹ Garth Johnson, *Jour. Parasitol.*, 28: 369, 1942.

¹² Garth Johnson and Margaret H. Trussell, *Proc. Soc. Exp. Biol. and Med.*, 57: 252, 1944.

¹³ Garth Johnson and Ray E. Trussell, *Proc. Soc. Exp. Biol. and Med.*, 54: 245, 1943.

¹⁴ Ray E. Trussell and Garth Johnson, *Am. Jour. Obst. and Gynec.*, 48: 215, 1944.

¹⁵ The authors are indebted to Drs. E. D. Plass, W. E. Brown and H. W. Pichette for procuring the specimens.

This mistaken use of the true plant gall and the fact that the short-styled pistillate flower of the fig inhabited by the fig insect (*Blastophaga psenes*) has a swollen appearance may be the basis for the use of the misnomer "gall-flower."

Dr. Ivan M. Linforth, University of California, Berkeley, informs us (in lit.) that in the Greek "psenes" translated by Sir Arthur Hort as "gall insects" there is nothing to suggest that the insects in question had anything to do with galls.

The misconception concerning the relation of *Blastophaga* to the fig still persists, as witness the statement by Imms² that "the eggs of this chalcid are laid in the ovaries of the caprifig and give rise to galls therein."

In 1882 Solms-Laubach³ reported that the female flowers of the fig are transformed by the puncture of fig insects into flower galls ("sie werden durch dessen Einstich in Blüthengallen verwandelt"). He stated definitely that these flowers represent a gall formation comparable to that of various other known types of galls such as *Verbascum* and the "Radenkörnern" of wheat. Solms-Laubach⁴ also studied various species of *Ficus* in Java and found that the fruits of some trees possessed flowers especially adapted to oviposition by fig wasps. These degenerated or differentiated female flowers he called gall flowers (Gallenblüthen) which seemed to have lost their ability to produce seed. Caprifigs contained these gall flowers almost to the exclusion of any female flowers.

Then we find that King⁵ described five kinds of flowers occurring in fruits of the genus *Ficus*—male, pseudo-hermaphrodite, neuter, fertile female and gall flowers. His own name for the fifth kind was originally "insect-attacked female flowers," but he later adopted the "shorter and more suitable" name used by Solms-Laubach.

In 1896 Gustav Eisen⁶ wrote as follows:

The gall flowers, which occur in abundance in all caprifigs of all crops, are in reality nothing else than female flowers which have been transformed in order to accommodate the requirements of a small wasp, the *Blastophaga psenes*. These gall flowers are not able to produce seed, though in general aspect they resemble the female flower. . . . That the gall flower is a degenerated female flower

is certain, as in some varieties it yet depends upon chance which flowers are to be gall flowers and which are to remain female flowers. Those pierced by the wasps develop into galls, those which are not pierced remain female flowers. In our present caprifig, the female flowers, even if pierced by the ovipositor of the *Blastophaga*, will never become gall flowers.

At this point we may state that in the light of our present knowledge there are only two kinds of pistillate flowers in figs, long-styled flowers found in edible figs, and short-styled flowers found in caprifigs. All pistillate fig flowers are potentially fertile; if pollinated and fecundated they all may produce viable seed. The *Blastophaga* oviposits in the short-styled flowers, an act which precludes growth of a pollen tube through the stylar canal. No investigator has yet reported the presence of a larva and an embryo in the same ovary of a fig flower. Some short-styled flowers which escape *Blastophaga* oviposition may be pollinated and develop fertile seed. The above-mentioned authors do not give the exact morphological differences between the female and so-called gall flowers of the caprifig. We maintain that they are not different but identical.

The purpose of the present paper is to show that the terms "gall fig" and "gall flower" are both inaccurate and misleading. A gall fig has been defined as a caprifig because of the fig wasps which were supposed to develop within galls produced in these figs. The dictionary definition⁷ of gall flower is: "The degenerate pistillate flower found in certain varieties of the cultivated fig. These flowers can not develop seed, on account of their aborted ovaries." Our contention is that this definition is incorrect, that the pistillate flowers are not degenerate, that every flower has the capacity to develop a seed, and that there is rarely if ever any abortion of the embryo.

The misconception about fig flowers may be clarified by a proper understanding of the word gall. This is defined as a swelling or excrescence on a plant produced by some other organism. A gall is seldom, if ever, of any value to the host plant and may be decidedly injurious. In the short-styled pistillate flower of a fig there is no swelling or excrescence resulting from the presence of any stage of *Blastophaga* in the ovary. An insect-inhabited flower can not be distinguished by its form from an uninhabited flower. Furthermore, there is a symbiotic relationship between the *Blastophaga* and the fig, the former having a home and food supplied it, and the latter depending upon the insect for pollination of its flowers.

The usual result of pollination of a fig flower is formation of an embryo and eventually of a mature achene. An unpollinated fig flower, either long-styled

¹ E. Theophrastus, "Enquiry into Plants," 2 vols. New York: G. P. Putnam's Sons. Engl. translation by Sir Arthur Hort, 1916.

² A. D. Imms, "A General Textbook of Entomology," 727 pp. London: Methuen and Company.

³ H. G. Solms-Laubach, *Abhandl. K. Ges. Wiss. Göttingen*, 28: 11, 22, 1882.

⁴ H. G. Solms-Laubach, *Bot. Zeitung*, 43 (33-36): 15, 1885.

⁵ George King, *Ann. Royal Bot. Gard. Calcutta*, part 1, page V, 1887.

⁶ Gustav Eisen, *California Acad. Sci. Proc.*, Ser. 2, Vol. 5: 916, 937, 1896.

⁷ Webster's New Intern. Dict., 2nd ed., p. 1028. Springfield: G. and C. Merriam Company, 1934.

or short-styled, may develop an achene-like, empty ovary already designated a *cenocarp* by Condit.⁸ For such an ovary when inhabited by *Blastophaga psenes* we propose the name, *psenocarp*. A psenocarp differs from an achene in that *Blastophaga* occupies the position of the embryo.

It seems clear to us that the term "gall flower" should be omitted from future publications or, if used, be accompanied by a suitable definition. In redefining it the following statement should suffice: Gall flower, a term erroneously applied to short-styled fig flowers inhabited by fig insects; such flowers are normal and show no swelling or excrescences typical of galls. See Psenocarp.

IRVING J. CONDIT
STANLEY E. FLANDERS

UNIVERSITY OF CALIFORNIA

CITRUS EXPERIMENT STATION,
RIVERSIDE, CALIF.

A GUMMOSIS OF CITRUS ASSOCIATED WITH WOOD NECROSIS

STUDIES during the past seven years at the Lower Rio Grande Valley Experiment Station have disclosed that the most prevalent and most serious citrus tree disease in this section is a type of gummosis; and that the gumming arises from cracks in the bark overlying and connected with irregular bands of necrotic wood, the greater part of which lies well beneath the outer wood layers. Reference has been made to this disease in annual reports of the Texas Agricultural Experiment Station.

Cross sections through a gumming branch disclose the end views of the necrotic bands of wood lying often an inch or more beneath the surface, irregular in thickness (varying from one fourth to two inches) and varying in width from a fraction of an inch to several inches, sometimes extending to three quarters or more of the circumference. Longitudinal sections show that the longitudinal extension of the necrotic band is usually several times the lateral spread. Spread is both upward and downward in the trunk or branch.

Affected wood is firm, and only slightly darker in color than normal wood, except that the advancing border region is a more or less salmon pink, becoming brighter in color soon after exposure to the air. Histologic studies of transverse and longitudinal sections through the wood in the peripheral pink region disclose the presence of hyphae of extremely small diameter and of what appear to be spores of equal diameter budding off their tips. The organism is suggestive of an *Actinomyces* in appearance. Its advance through the tissues is both inter- and intracellular, and in medullary rays as well as in longitu-

⁸ Ira J. Condit, *Hilgardia*, 6(14): 459, 1932.

dinal wood fibers. Aside from the spore-like bodies mentioned, no fungus fruiting bodies of any kind have been found consistently associated with the organism. The dead wood, however, in the older necrotic regions, is invaded by secondary organisms, chief among which is *Diplodia natalensis*.

Numerous attempts to isolate the primary organism in pure culture on ordinary organic nutrient culture media and on synthetic media have thus far failed. Inoculations into healthy branches, following the usual preparatory aseptic measures, using pink border wood as the inoculum and placing it well into the wood in a chisel wound, have in most cases brought about typical spreading necrotic bands in the wood, followed by gummosis. It would seem to be clear that this citrus tree disease is parasitic in origin. Points of entrance into the wood have been found in unprotected pruning wounds, particularly those large in diameter and with cracks or "checks" a half inch or more in depth; in branches broken by a storm; in wood injured and cracked by freezing; and in bark injuries made by the shoes of pickers and pruners. Spread is at times rapid. A spread of one and one half feet downward in thirty days occurred in one case under observation.

Exploratory excavations of affected trunks, to learn the extent of the path of spread, have disclosed that downward spread appears to stop at the line of bud union between the root stock and the top. The sour orange root stock would thus appear to be immune. The disease occurs commonly in sweet orange, grapefruit and the Meyer lemon.

G. H. GODFREY

LOWER RIO GRANDE VALLEY SUBSTATION,
TEXAS AGRICULTURAL EXPERIMENT STATION

WHY THE RAINBOW AND THE CORONA NEVER ARE SEEN IN THE SAME CLOUD

NEARLY every good book on general physics explains (very inadequately, as a rule) how the rainbow is formed by the action of water drops on incident light from the sun or the moon, and some of them explain how the corona or small rainbow-colored ring around the sun or moon also is caused by water drops, but why, then, one never sees a rainbow in the corona-producing cloud appears always to be left to the reader to figure out for himself, which, presumably, he generally forgets to do.

Well, anyhow, the reason is that while a rainbow must be produced by the same cloud that shows the corona, it is too broad and indistinct, owing, as explained in Humphreys' "Physics of the Air" and elsewhere, to the minuteness of the drops to be clearly discerned. Perhaps, though, it might occasionally be glimpsed by persons of keen vision on looking at the right place (where the topmost portion of the usual

bowl would be) and knowing what to look for. The chance of success would justify many trials, for the game would be worth the candle.

W. J. HUMPHREYS

THE NAMING OF METHODS, PROCESSES AND TECHNIQUES FOR AUTHORS

FOR some time, it has been the custom to give the name or names of authors to various types of discoveries and methods. However, it is not always easy to assign credit to a particular individual, since two or more workers or scientific groups may announce some new fact or series of facts at about the same time. There are probably a great number of such instances that have occurred and the following serve to illustrate the point: (1) the discovery of oxygen by Scheele and Priestley, and (2) the isolation of and the identification of crystalline Vitamin C by King and Szent-Györgyi.

The purpose of this note is to call attention to the name of the reaction or process for determining alcohol by the potassium bichromate-sulphuric acid method. In 1846, Thomson¹ announced that alcohol was oxidized to aldehyde in the presence of potassium bichromate and sulphuric acid and that the green oxide of chrome was produced, in an article, "On the Mode of Testing the Presence of Minute Quantities of Alcohol." It was not until 1896 that Nieloux² reported the use of this reaction in a method for determining alcohol. However, the recent literature gives credit to Nieloux for the method, and some authors have even called it the Nieloux method.

The oversight by Nieloux in not referring to the paper by Thomson does not detract from the latter's report, and, because of the priority of this report, we suggest that the procedure that involves the reduction of a potassium bichromate-sulphuric acid solution be named the Thomson-Nieloux method. The solution not only gives a green color with alcohol, but it does when it is treated with a variety of substances such as glucose, levulose, formalin, paraldehyde, diethyl ether, ethyl acetate and lactic acid.

It is possible that Nieloux did not notice the paper by Thomson, since that sort of oversight has inadvertently happened many times. One is often aware that the authors of certain publications have either made no great effort to search the literature or else ignored contributions by other individuals.

The reason for not referring to previous work in one's field of study is always difficult to explain and the custom, if practiced continuously, will lessen the

value of one's contributions. The custom of using only the references to papers from one's own laboratory or chiefly those references by one's countrymen seems to be practiced more widely in some other countries than in the United States. This latter condition might be partially explained by the fact that numerous abstracting and indexing facilities are readily available to most scientists in this country.

S. ANDERSON PEOPLES

BAYLOR MEDICAL COLLEGE,
HOUSTON, TEXAS

EMMETT B. CARMICHAEL

SCHOOL OF MEDICINE,
UNIVERSITY OF ALABAMA

GOVERNMENT AID TO EDUCATIONAL INSTITUTIONS

DR. COWDRY's article in the June 22, 1945, issue of SCIENCE ably presents the plight of endowed institutions of higher learning resulting from the drying up of endowment sources and the fall in interest rates. As a remedy he advocates a federal subsidy in the form of permission to purchase specially issued Government bonds yielding an interest rate higher than that presently obtainable on other securities, but desires that the aid be granted without federal control being exercised upon the institutions thus aided.

There appears to be a feeling that Government control is akin to a plague which defiles whatever it touches. While some projects may have experienced unfortunate results under Government control, others, such as the Interstate Commerce Commission and the Securities Exchange Commission, are admitted even by their early critics to have substantially achieved their objects; and may I suggest that, in any case where a grant of public money is involved, the granting of such money for any project, however worthy, without suitable controls, would be a betrayal of public trust. When private wealth bestows its largess upon educational institutions, it invariably does so under carefully stipulated conditions. By what logic can it be maintained that public funds should be granted to the same institutions without Government control being exercised in the public interest?

However excellent our private institutions of advanced learning may be, and however well they may have carried the torch of independent thought, it is rumored that certain undemocratic practices have crept into the administration of some of them relating to discrimination in the faculties and student bodies against certain groups. It would therefore appear that any Government subsidy should be granted only on full compliance with certain minimum requirements. An institution to receive such help should be one in which:

¹ Robert D. Thomson, *Monthly Jour. Med. Sc. London*, 6: 411-413, 1846.

² Maurice Nieloux, *Compt. rend. Soc. de biol.*, 10.s., 3: 841-846, 1896.

(1) the faculty is chosen solely on the grounds of professional competence, teaching ability and personal integrity; and

(2) the student body is admitted solely on the criteria of ability to assimilate and profit by the instruction given (again assuming personal integrity); and Government supervision adequate to enforce compliance with such requirements should, in the public interest, be instituted in respect to those institutions receiving the subsidy.

Dr. Cowdry quotes from Mr. Hilpert, a professor of constitutional law, to establish the legality of such subsidies. Professor Hilpert holds that granting such "would not exceed the delegated powers of Congress" and "would not violate the due process clause of the Constitution." I am not qualified to pass upon these two *dicta*, but I should like to direct attention to the third conclusion of Professor Hilpert, that the proposed scheme does not "constitute an establishment of religion in violation of the First Amendment, *even if benefits are extended to so-called sectarian institutions*"; to support which, he adds: "Realistically, sectarian colleges and universities (I exclude avowed theological seminaries) *do not exist to perpetuate a religion but to provide secular education . . .*" [italics mine].

While this may be true in a measure for certain sectarian colleges of the so-called "more liberal" sects, it is scarcely the case with many others. Though the latter sectarian colleges may teach some non-controversial subjects substantially as they are taught in secular institutions, their teachings in other subjects are colored by their particular sectarian doctrines in a manner which can scarcely provide what may be termed a "secular education." And as to the suggestion that such sectarian institutions "do not exist to perpetuate a religion"—the exact opposite would appear to be the situation. This is evidenced by the active support they receive from their respective sects,

the assiduity with which new institutions of this class are sought to be founded, and by the reports in the daily press of the many sermons and sectarian addresses which inveigh against so-called "Godless" education, *i.e.*, the secular education, the providing of which Professor Hilpert naively suggests is the object of the generality of sectarian colleges.

According to the current "World Almanac," the followers of the 256 different religious bodies in the United States, in the 1936 census, numbered some 56,000,000. Thus more than one half our population is without religious affiliation. Regardless of any technical constitutional interpretation, what equity could be claimed for a scheme which would tax the greater part of our population without religious affiliation to provide support for religious institutions of the lesser part? And in a democratic society, the argument is just as potent were the proportions reversed. To the non-legal mind, at least, the granting of such a subsidy to sectarian institutions seems to contravene the spirit, if not indeed the letter, of the constitutional provision against the establishment of religion.

It would seem, therefore, that there should be added to the two minimum requirements as to which an institution of higher learning (or in fact any educational institution of whatever grade) must qualify before receiving any public funds, another which would provide that in order to receive such help:

(3) the institution shall not be controlled by or affiliated with any religious sect or organization, shall not require any religious qualification of any of its governing personnel or boards, or of its faculty, or of its student body, and shall not require attendance at any course in religious instruction, or at any religious services.

The subsidy which Dr. Cowdry advocates, if protected by the three fundamental restrictions suggested, might well be deemed to be in the public interest.

ANDOVER, MASS.

HAROLD R. RAFTON

SCIENTIFIC BOOKS

AMERICAN FORESTS

Behold Our Green Mansions. A Book about American Forests. By RICHARD H. D. BOERKER. xiv + 313 pp. 96 full-page plates from photos, arranged through the text in groups of sixteen, plus numerous maps, graphs and tables of data. The University of North Carolina Press. 1945. \$4.00.

THIS book, bound in blue cloth with green title patch, is essentially a volume on the scientific and practical aspects of forest conservation in the United States. It has been written by a man who has spent

his entire professional career of thirty-five years very close to the subject. At the outset he outlines his purpose to depart from the traditional, passive, "woman's club" ideas of conservation and to accept as his guiding light the more dynamic and scientific principles that underlie the restoration and maintenance of American forests for multiple use and with human welfare in a very broad sense as the ultimate object.

The book contains about all that one could wish in a one-volume treatment of so complex a subject. It impresses us as one of the very best publications

on this topic that has appeared during the past twenty-five years.

After a brief treatment of the historical aspects of our treatment of American forests, including an outline of natural forest regions and the regions of present commercial saw timber, Dr. Boerker plunges into a consideration of the manifold relationships of forest products to the nation in time of peace and war. The importance of forests in our recreational program is given appropriate treatment, and we learn that about 45,000,000 acres of forest land will be needed by all types of recreation in the future. The relation of forests to wild life, water supply, erosion, soil conservation and flood control are treated in several special chapters and are referred to in many other places throughout the text. It is good to note that the results of rather recent researches are reflected in the discussion of these and many other topics. Reference is made to the still lingering differences that exist among the experts regarding many of the natural relationships of forests. In this connection the author stresses the wisdom of the old Chinese belief that "the mightiest rivers are cradled in the needles of the pine trees."

The discussion of lumber and its by-products includes reference to some of the newer synthetic and fabricated materials that have become of great commercial value. The importance of the forest as a livestock range is indicated by the statement that of the 600,000,000 acres that are classified as forest land in the United States over one half is used for grazing purposes. Forty per cent. of all the mature range cattle in the western states graze on forest lands for at least a part of the year. Many of our most fundamental economic and social problems as well as numerous controversial scientific attitudes are involved in the relationships between forests and livestock. The conflict between federal and private management of such resources is still a live topic in the West.

Some of the most impressive sections of this excellent book are those that present an introduction to the destroying agents of fire, fungi and insects to which forests are constantly exposed. The terribly destructive influence of these factors, especially of fire, have now become fairly familiar to many reading Americans. That insect enemies of the forest take a toll of \$100,000,000 a year can scarcely be sensed by the average American, however, or that a single species of parasitic fungus could practically wipe out one of our most important hardwood trees in less than fifty years. The findings of the forest entomologists and forest pathologists admirably illustrate the scientific complications of modern forestry, and indeed of conservation of natural resources in general.

The author properly devotes considerable space in

special chapters to the consideration of the leadership of the federal government in American forestry. Numerous other references to this well-known and significant feature recalls a former book, "Our American Forests," that Dr. Boerker published in 1918. And the controversies that still hound American forestry over the question as to public versus private management of our forest resources are also touched. The author is quite objective and impartial in the presentation of most of his material, but on this question, after a passing reference to the differences of opinion, he clearly indicates that his own attitude is to favor increasing governmental control and management of such important and nationwide matters.

The role of the various states in forest restoration and the forestry problems that are peculiar to the various sections of the nation are topics of special chapters, as are the special economic and social factors involved in private forestry. This extremely attractive book is concluded with a good index.

Dr. Boerker's new book is thoroughly documented and reliable, and the University of North Carolina Press has done an excellent job of manufacturing the volume. It can be warmly and confidently recommended to every American, old and young, who is seriously interested in the future welfare of his nation. It will serve as an admirable guide for any group or class that wishes to undertake a special study of forest conservation.

RAYMOND J. POOL

UNIVERSITY OF NEBRASKA

EBULLIOMETRIC MEASUREMENTS

Ebulliometric Measurements. By W. SWIETOSLAWSKI, professor in absentia of physical chemistry of the Institute of Technology, Warsaw; senior fellow, Mellon Institute of Industrial Research. xi + 228 pp., 64 figs. Reinhold Publishing Corporation, New York, N. Y., 1945. \$4.00.

IN 1936 an English edition of "Ebulliometry" was published in Cracow, and in 1937 a photolithotyped edition with supplements appeared in the United States. The latter has been rewritten and new developments have been included to form this new edition. The book is a unique source of authoritative and concise information on modern ebulliometric methods, most of which have been developed by the author or under his direction. The description of experimental technique and the illustrations of apparatus are of such clarity and detail that it can serve as a laboratory manual as well as a text of principles and a handbook of valuable information, data and references. The advantages, in simplicity, convenience and precision, of the method of comparative measurements are explained and emphasized throughout the

monograph. Primary and secondary standards and their requisite properties for comparative ebulliometric measurements are discussed.

Among the ebulliometers described are:

An improved simple ebulliometer for the precise determination of boiling points and changes in barometric pressure.

The differential type, with and without fractionating columns between thermometer wells, for comparing boiling and condensation temperatures, testing for purity, determining molecular weights, measuring solubilities and constructing diagrams of boiling point plotted with respect to composition of mixtures.

An ebulliometer for mixtures containing small amounts of highly volatile components.

One for measuring condensation temperatures of vapors before and after passing through a rectifying column.

A multi-stage ebulliometer with four thermometer wells to measure boiling points and condensation temperatures at several points along a column.

Ebulliometers for systems having two-liquid phases.

A universal ebulliometer composed of interchangeable standardized units of specified dimensions provided with ground joints of standard taper. This is a particularly desirable innovation, since with these parts it is possible to construct quickly any of several types of ebulliometers.

Modifications for the application of electrical heating and redesigned thermometer wells for use with ordinary Beckmann thermometers are illustrated.

Some idea and appreciation of the variety of the topics and applications described can be gained from the following captions of the eighteen chapters: ebulliometric measurements; classification of liquid mixtures; method of comparative measurements; calibration of thermometers and measuring of changes in pressure; determination of the degree of purity of liquid substances; applications of ebulliometers to the study of azeotropy; purification of liquid substances and microebulliometric determination of impurity content; microebulliometric determination of moisture content; microebulliometric determinations of impurity content in solid substances; ebulliometric examination of thermal resistivity (resistivity here refers to resistance to decomposition); microebulliometric determination of the amount of vapors adsorbed by solid substances; macroebulliometric determination of moisture; molecular weight determination of solid substances; boiling and condensation phenomena observed under high pressure; ebulliometric measurements under high pressure; determination of the solubility of solid substances; ebulliometric method of determination of equilibrium constants; ebulliometric examination of physicochemical standards. A

postscript, a numbered bibliography of references, author index and subject index close the volume.

The printing is good and the illustrations are clear, which could not be said of the previous edition. Very few errors were noted and these are minor and obvious. This new edition should prove even more popular and useful than the previous one. It should be included in the library of every chemist and physicist connected with industrial distillation, research on the physical properties of pure liquids and solutions or teaching physical chemistry.

EDGAR REYNOLDS SMITH

INFINITE SERIES

Infinite Series. By J. M. HYSLOP. xi + 120 pp. New York: Interscience Publishers, Inc. 1942. \$1.75.

THIS book furnishes an excellent account of the fundamental features in the convergence theory of real series. Some space is allotted to the discussion of complex series and infinite products. Also, a chapter is devoted to the more important properties of double series.

The book is intended for the student who wishes to acquire a good working knowledge of the theory of infinite series after acquiring a grasp of the fundamentals of elementary analysis. Some of the theory concerning functions and limits that might not be presupposed in this case is given in the first two chapters.

In view of the steadily increasing use of summability theory in current works dealing with infinite series and their applications, it seems to the reviewer that it would have been worth while to have touched on this field, as the simpler phases of it are no more difficult than other topics treated in the book. In particular, since there is a chapter on the multiplication of series, Cesàro methods and their application to this problem might well have been discussed at that point.

CHARLES N. MOORE

UNIVERSITY OF CINCINNATI

BOOKS RECEIVED

FRITSCH, F. E. *The Structure and Reproduction of the Algae; Vol. II, Phaeophyceae, Rhodophyceae and Myzophyceae.* Illustrated. Pp. xii + 939. Cambridge University Press, The Macmillan Company. \$12.00. 1945.

JOHNSON, MARTIN. *Time, Knowledge and the Nebulae.* Pp. 189. Faber and Faber, London. 12/6. 1945.

RAHN, OTTO. *Injury and Death of Bacteria by Chemical Agents.* Illustrated. Pp. 183. Biodynamica, Normandy. Missouri. \$3.60. 1945.

ROUSSEAU, JACQUES. *L'Hérédité et L'Homme.* Pp. 250. L'Arbre, Montreal. 1945.

THOM, CHARLES, and KENNETH B. RAPER. *A Manual of the Aspergilli.* Illustrated. Pp. ix + 373. The Williams and Wilkins Company. \$7.00. 1945.

VILLA, R., ALFONSO. *The Maya of East Central Quintana Roo.* Illustrated. Pp. xii + 182. Carnegie Institution of Washington. \$2.25. 1945.